APPENDIX B
MODELING DESCRIPTION

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List of Acronyms

(AFRP) .... Anadromous Fisheries Restoration Program
(ASIP) .... Action Specific Implementation Plan
(ATSP) .... Automated Temperature Selection Procedure
(CDFG) .... California Department of Fish and Game
(CESA) .... California Endangered Species Act
(COA) .... Coordinated Operations Agreement
(CVP) .... Central Valley Project
(DMC) .... Delta-Mendota Canal
(DSA) .... Depletion Study Area
(DSM2) .... Delta Simulation Model II
(DWR) .... California Department of Water Resources
(E/I) .... Export/Inflow
(EIS/EIR) .... Environmental Impact Statement/Environmental Impact Report
(ESA) .... Federal Endangered Species Act
(EWA) .... Environmental Water Account
(FERC) .... Federal Energy Regulatory Commission
(FRSA) .... Feather River Service Area
(GATAER) .... Graphical and Tabular Analysis for Environmental Resources
(ID) .... Irrigation District
(IMPLAN) .... Impact Analysis for Planning
(I-O) .... input-output
(JPOD) .... Joint Point of Diversion
(LOD) .... level of development
(M&I) .... municipal and industrial
(MAF) .... million acre-feet
(MAF/Yr) .... MAF per year
(MOU) .... Memorandum of Understanding
(NOAA Fisheries) .... National Oceanic and Atmospheric Administration, National Marine Fisheries Service
(NWR) .... national wildlife refuge
(PG&E) .... Pacific Gas and Electric Company
(Reclamation) .... U.S. Bureau of Reclamation
(ROD) .... Record of Decision
(RWQCB) .... Regional Water Quality Control Board
(SWP) .... State Water Project
(SWRCB) .... State Water Resources Control Board
(TAF) .... thousand acre-feet
(TCD) .... Temperature Control Device
(TUs) .... Temperature units
(UCCE) .... University of California Cooperative Extension
(USFWS) .... U.S. Fish and Wildlife Service
(WA) .... Water Agency
(WD) .... Water District

APPENDIX B
MODELING DESCRIPTION

1.0 Introduction

The Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Environmental Water Account (EWA) Program includes an evaluation of potential impacts upon environmental resources that may result from the purchase, storage, and conveyance of EWA assets and the actions taken by the EWA to benefit fish populations. Flow-related effects for the resource areas included for analysis in the EWA EIS/EIR are based upon the results of hydrologic modeling, including the CALSIM II 2001 benchmark study (BST_2001D10A), and other related studies as described in this attachment.

The EWA EIS/EIR provides an assessment of the Flexible Purchase Alternative, the Fixed Purchase Alternative, and the No Action/No Project Alternative. Under the Flexible Purchase Alternative, EWA agencies may purchase between 35 thousand acre-feet (TAF) and 600 TAF annually from areas in the Upstream from the Delta Region and the Export Service Area. The Fixed Purchase Alternative represents management of annual EWA water assets of 185 TAF from areas within the Upstream from the Delta Region and the Export Service Area, with a maximum of 35 TAF obtained from the Upstream from the Delta Region. The No Action/No Project Alternative is defined as the reasonable foreseeable future condition without the EWA, based on legal and regulatory constraints. Detailed descriptions of these alternatives are provided in Chapter 2 of the EWA EIS/EIR. For purposes of the ASIP, the EWA Proposed Action is identical to the Flexible Purchase Alternative and the basis of comparison is identical to the Baseline Condition, as referred to in this document.

The resource effect analyses evaluate the potential effects of the Proposed Action in a quantitative manner, based on the hydrologic, water temperature, salmon mortality modeling, and the CVP and SWP pumping plants salvage calculations performed for the project, and described in this document. Additionally, as described in Chapter 2 of the EWA EIS/EIR, the Baseline Condition represents the No Action/No Project Alternative, therefore, there would be no utility in developing an additional simulation and conducting such a comparison. The Fixed Purchase Alternative is not a part of the EWA Proposed Action, therefore, the Fixed Purchase Alternative and the No Action/No Project Alternative are not specifically addressed in this document.

This document provides detailed information regarding the hydrologic modeling tools, primary assumptions, model inputs, and methodologies used to evaluate potential environmental effects of the EWA Proposed Action upon the resource areas that may be affected by the coordinated operations of the SWP and CVP facilities (Projects) within the EWA action area. The evaluation of potential effects compares the effects of conveying water from the area of purchase to the Delta and the effect of pumping that water from the Delta via the California Aqueduct and the Delta Mendota Canal to O'Neill Forebay. The area of analysis (study region or action area) for each resource topic is defined within the resource-specific chapter of the EWA EIS/EIR.

The effect assessments in the EWA EIS/EIR for fishery resources are based on comparisons made between computer model simulations developed to represent hydrologic, regulatory, structural and operational parameters for a Baseline Condition (existing, without project) and the Flexible Purchase Alternative (future, with project). Modeling tools used to simulate these conditions include the Department of Water Resource's (DWR's) CALSIM II (released July 23, 2002, with a 2001 level of development [LOD]) the U.S. Bureau of Reclamation's (Reclamation's) water temperature and salmon mortality models, as well as related pre- and post-processing applications utilized to develop the simulations and evaluate the Proposed Action relative to the basis of comparison.

Because there can be no certainty in forecasting which combination of potential water assets will be available to the EWA Program on a year to year basis, the resource area analyses are subject to error regardless of the assets selected for evaluation. In an effort to capture the maximum effect of EWA purchases by resource area, multiple methods of simulation post processing were employed. Specifically, the first method describes the maximum effects on the locations of water purchase and the second method describes the maximum effects of utilizing the purchased water.

In the first method, four post-processing simulations were performed to identify regional effects of EWA water purchases. Each simulation utilized a single specific asset from the Upstream from the Delta Region (Sacramento River, Feather River, Yuba River, American River, and San Joaquin River) to meet the available July through September EWA export. The simulation was performed for each year of the modeling period of record. Since no single region has sufficient assets to meet a 600 TAF export need, there are many years when all of a region's assets are used but EWA exports are not met. For this methodology, however, regional upstream effects on vegetation, wildlife, visual, recreation, and flood control resource areas are maximized (magnitude of reservoir drawdown, amount of idled acreage) due to the frequent and total use of the assets. Detailed results from these four simulations are provided in Appendix H, Summary and Technical Output for the Graphical and Tabular Analysis for Environmental Resources (GATAER), of the EWA EIS/EIR.

Because any single simulation in the first method cannot meet the total EWA export potential, a second method was used to maximize effects associated with EWA exports. This second method was incorporated in a single simulation using all available EWA assets from the Upstream from the Delta Region to meet the maximum EWA export potential (limited to 600 TAF). The simulation was performed for each year of the modeling period of record. This methodology was used for the analysis of potential effects on fish, water quality, Project water supply & management, and power resource areas because it imposes the largest overall change to instream flows and Delta operations. Detailed results from this simulation are provided in Appendix H of the EWA EIS/EIR.

Additionally, two water purchase scenarios that are subsets of the second method described above were created to better evaluate potential effects on aquatic resources within the Delta Region. The Delta assessment involved consideration of two separate EWA water purchase scenarios under the Proposed Action: 1) Maximum Water Purchase Scenario; and 2) Typical Water Purchase Scenario. The Typical Water Purchase Scenario assumes a range of EWA asset water purchases from the Upstream from the Delta Region depending upon water year type. Although referred to as a "typical" scenario, this scenario, like the Maximum Water Purchase

Scenario, assumes that all unused Delta export pumping capacity for the summer months (July through September) would be available to the EWA Program. While this assumption permits evaluation of the potential worst-case for EWA export pumping, there are other water acquisition and transfer programs and SWP/CVP programs that have priority access to use this available pumping capacity. Therefore, this scenario does not necessarily represent the conditions that would be expected to occur for any given year of the program. Instead, this scenario may be considered to represent conditions that are more likely to occur than those assumed for the Maximum Water Purchase Scenario. The reasons for developing these two separate water purchase scenarios and the key assumptions for each are provided in Section 2.2.2.2.

This document also describes the evaluation assumptions and methodologies developed to determine the net benefit to Delta fish species of primary management concern based upon an assessment of anticipated reductions in fish salvage at the Projects' Delta facilities. The results of the Delta salvage evaluation are included in this document, as well as in Chapter 9 of the EWA EIS/EIR, and in Chapter 4 of the Action Specific Implementation Plan (ASIP).

1.1 Purpose and Implementation of the EWA Program

The purpose of the EWA is to provide a highly flexible, immediately implementable, water management strategy with a primary focus of protecting at-risk native fish species affected by CVP/SWP operations and facilities through improvement of aquatic habitat conditions and contribution to the recovery of Delta-dependent native fish species of concern. The EWA is intended to improve aquatic habitat conditions primarily by using EWA assets to reduce CVP/SWP Delta export pumping during periods (months) critical to fish species listed as threatened, endangered or as candidate species under either the Federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA), or both. Additionally, the EWA Program is designed to provide for the timely management of water resources in response to changing environmental conditions and fish protection needs, delivery of reliable water supplies to south of Delta water users, and prevention of uncompensated water costs to the Projects' water users.

The EWA Proposed Action (Flexible Purchase Alternative) would permit the purchase and acquisition of up to 600 TAF of water assets annually, to apply toward the attainment of CALFED goals and EWA objectives to reduce existing conflicts between the various uses of water resources in the Delta. Implementation of the Proposed Action assumes maximum surface water contributions from identified available contributory sources (see ASIP, Chapter 2). Asset acquisition and water management under the Proposed Action encompasses areas both in the Upstream from the Delta Region and the Export Service Area.

The EWA agencies can utilize variable operational assets and acquire fixed assets (assets), and then allocate water to improve targeted fisheries resources (fish actions or EWA actions). Variable operational assets include flexibility in regulatory requirements (relaxation of Export/Inflow (E/I) ratio for the purpose of providing benefits to fish) and SWP pumping of instream improvement flows upstream from the Delta utilizing Central Valley Project Improvement Act section 3406 b(2) (CVPIA b(2)) and Ecosystem Restoration Program (ERP) water. Fixed assets are water purchased from willing sellers. The EWA agencies evaluate the available assets and select appropriate actions according to a monthly accounting system and practices as determined by the needs of the system and availability of water.

The CALFED agencies managing the EWA Program consider a variety of factors or variables in their decision-making process regarding water purchases prior to and during each water year. In this manner, the agencies must adaptively manage the program to ensure sufficient assets are acquired to enable the agencies to provide benefit to Delta fish resources. Several key factors that affect this decision-making process are listed below:

- The amount of funding available for that years water purchases.
- The amount of export capacity available to the EWA at the Banks and Tracy pumping plants during periods that the EWA must convey water through the Delta to O'Neill Forebay.
- The amount of water that will be purchased upstream of the Delta, which depends on the available export capacity, the amount of funds available for water purchases, the amount of EWA water required that year, and the amount of water available for purchase.
- The amount of variable assets that may be available in a specific year, especially with respect to the amount of water the EWA may gain through relaxation of the E/I ratio.
- The amount of CVPIA b(2) water available to support pumping reductions at the CVP's Tracy Pumping Plant.
- Unknown and variable hydrologic conditions.
- Unknown and variable climatic conditions, with ambient temperature being the most important climatic variable because of the affect of water temperature on fish migration, spawning, and other life stages.

2.0 Effect Analysis Framework

This section describes the effect analysis framework developed to evaluate potential flow-related effects upon aquatic resources due to implementation of the EWA Program. Specifically, the hydrologic and related modeling analyses (water temperature and salmon mortality) and post-processing applications were utilized to simulate the operations associated with the Proposed Action. The overall intent of the modeling simulation comparisons was to evaluate the potential effects of conveying EWA assets (water) from the area of purchase (Upstream from the Delta Region) to the Delta and the effects within the Delta associated with pumping the water from the Delta via the CVP and SWP facilities to the O'Neill Forebay. The results of the modeling simulation comparisons are presented in the EWA EIS/EIR Chapter 9, Fisheries and Aquatic Ecosystems; and Chapter 4 of the ASIP.

The effect analysis framework also describes the evaluation of the benefits realized for Delta-dependent fish species that result from the implementation of the EWA fish actions. The level of benefit derived from the Proposed Action (Flexible Purchase Alternative) is determined based upon calculations of anticipated reductions in fish salvage at the Projects' Delta pumping facilities. Reductions in fish salvage would occur due to implementation of the EWA fish actions that reduce export pumping volumes during months when fish species of concern are known to be present in the Delta.

2.1 Models Used for the Hydrologic Effect Analysis

Computer simulation models of water systems provide a means for evaluating changes in system characteristics such as carryover storage, reservoir water elevation, river flow rate and power generation, as well as the effects of these changes on environmental parameters such as water temperature and early-lifestage Chinook salmon survival. The models used to simulate the basis of comparison (Baseline Condition) and Proposed Action (Flexible Purchase Alternative) include the following:

- DWR and Reclamation Simulation (CALSIM II) model of the integrated CVP and SWP system operations;
- Yuba River Basin Model (HEC-5) developed by Bookman-Edmonston Engineering, Inc. in collaboration with DWR;
- Post Processing Tool for the evaluation of EWA water purchases (EWA Water Purchases.xls);
- Post Processing Tool to route the EWA water purchases and produce the "virtual" CALSIM II output databases (EWA Routing.xls);
- Reclamation Trinity, Shasta, Whiskeytown, Oroville, and Folsom reservoir water temperature models;
- Reclamation American, Feather, and Sacramento river water temperature models;
- Reclamation American and Sacramento river early-lifestage Chinook salmon mortality models;
- GATAER Tool; and
- DWR Delta Simulation Model II (DSM2); the delta hydrodynamic and salinity model for water quality.

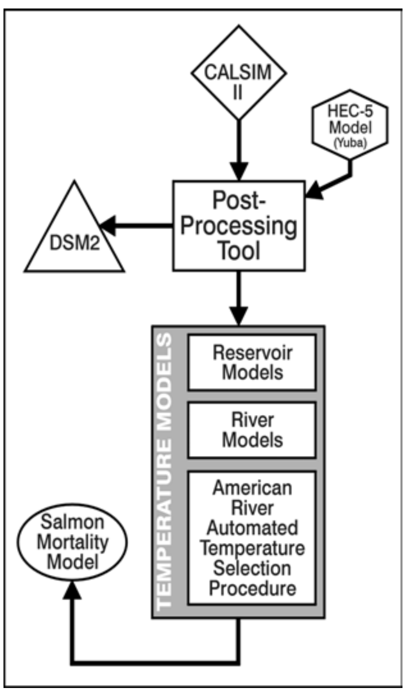

Figure 1
Schematic diagram of the hydrologic modeling process

A schematic diagram illustrating the hydrologic modeling process is provided in Figure 1. CALSIM II provides a benchmark monthly simulation of the CVP and SWP water operations without any EWA actions. Output from CALSIM II and the HEC-5 model were then used as input to post-processing tools, EWA Water Purchase.xls and EWA Routing.xls, to develop the EWA Actions and the "virtual" CALSIM II output databases for the EWA analysis. CALSIM II provides hydrologic information for the reservoirs (inflows, reservoir releases, and storage), rivers (flow), and other operating parameters (Project pumping). Many of these parameters are used as effect indicators in the EIS/EIR (see Chapters 9 for additional detail; also see GATAER output in Appendix H of the EWA EIS/EIR).

The "virtual" CALSIM II output databases were then used to generate the inputs required for the DSM2 and temperature models. The temperature model output was then used to generate the inputs to the early lifestage Chinook salmon mortality models.

Finally, the GATAER tool was used to generate the information needed for the effect analysis in the form of tables and graphs for the outputs of the previous modeling.

These models and related post-processing tools are described in the following sections.

2.1.1 CALSIM II Model

CALSIM II is currently DWR's and Reclamation's primary operations and planning model for SWP and CVP project operations. The model simulates CVP and SWP system operations and the hydrologic effects of those operations within the geographical area affected by CVP and SWP facilities, including the Delta. The major Central Valley rivers, reservoirs and Project facilities are represented by a network of computation points or nodes.

CALSIM II uses a mass balance approach to simulate the occurrence, regulation, and movement of water from one river reach (computation point or node) to another. At each node, various physical processes (e.g., surface water inflow or accretion, flow from another node, groundwater accretion or depletion, and diversion) can be simulated or assumed. Operational constraints, such as reservoir size and seasonal storage limits or minimum flow requirements, also are defined for each node. The model uses a monthly time step. Accordingly, flows are specified as a mean flow for the month, and reservoir storage volumes are specified as end-of-month content.

CALSIM II simulates monthly operations of the following water storage and conveyance facilities:

- Trinity, Lewiston, Whiskeytown, and Shasta/Keswick reservoirs (CVP);
- Spring Creek and Clear Creek tunnels (CVP);
- Lake Oroville (SWP);
- Folsom Reservoir and Lake Natoma (CVP);
- New Melones Reservoir (CVP);
- Millerton Lake (CVP);
- Tracy (CVP), Contra Costa (CVP), and Banks (SWP) pumping plants;
- San Luis Reservoir (shared by CVP and SWP); and
- East Branch and West Branch SWP reservoirs.

To varying degrees, nodes also define SWP/CVP conveyance facilities including the Tehama-Colusa, Corning, Folsom-South, and Delta-Mendota Canals and the California Aqueduct.

Other non-SWP/CVP systems tributary to the Delta are also modeled in CALSIM II, including:

- New Don Pedro Reservoir;
- Lake McClure; and
- Eastman and Hensley Lakes.

The model simulates one month of operation at a time, sequentially from one month to the next, and from one year to the next for 72 years. Each decision that the model makes regarding stream flow regulation is the result of defined operational requirements and constraints (e.g., flood control storage limitations, minimum instream flow requirements, Delta outflow requirements, diversion assumptions) or operational rules (e.g., preference among reservoirs for releasing water). Certain decisions, such as the definition of water year type, are triggered once a year, which affects water delivery allocations and specific stream flow requirements. Other decisions, such as specific Delta outflow requirements, are dynamic from month-to-month. CALSIM II output is represented by flow or storage conditions at each node on a mean monthly basis.

Although a set of EWA actions is built into the CALSIM II model, the actions in the model do not match the EWA actions evaluated in the EWA EIS/EIR. Because the intent of the analysis performed in the EIS/EIR is specifically to evaluate the EWA Program, the modeling operations performed with CALSIM II were halted before the model encountered the conditions specific to EWA implementation. The CALSIM II benchmark study "wrapper" included regulatory constraints defined to include D-1485 through CVPIA b(2).

This was done so that the program conditions pertinent to the EWA Proposed Action (Flexible Purchase Alternative) would be analyzed separately from all of the other CALSIM II parameters. After the modeling process utilizing CALSIM II was halted, the post processing tools (EWA Water Purchase.xls and EWA Routing.xls) were used to evaluate the conditions specific to EWA and its implementation.

2.1.2 Yuba River Basin Model

The Yuba River Basin Model is a HEC-5 model that has been developed and maintained by Bookman-Edmonston Engineering, Inc. in cooperation with DWR. Bookman-Edmonston Engineering, Inc. continues to collaborate with DWR to refine the system's operating criteria and update information on facilities, inflows (unimpaired flows), demands, and fishery flow requirements (Bookman-Edmonston 2000). The original HEC-5 operational parameters and criteria were obtained from DWR's HEC-3 model and these assumptions have undergone periodic modifications to reflect operational changes within the system as they have occurred.

HEC-5 is a general purpose program that simulates the operation of flood control and water conservation systems. Like CALSIM II, it relies on mass balance reservoir routing logic to simulate the occurrence, regulation, and movement of water from one river reach (computation point or node) to another. Various physical processes (e.g., surface water inflow or accretion, evaporation rates, flow from another node, groundwater accretion or depletion, and diversions) are simulated or assumed. Operational constraints, such as reservoir size, seasonal storage limits, minimum power generation quotas, or minimum flow requirements, also are defined for each node. The HEC-5 model uses a monthly time-step and an upstream-to-downstream procedure to simulate the operations of major water facilities in the Yuba River Basin (Bookman-Edmonston 2000).

2.1.3 EWA Water Purchases.xls Post Processing Tool

The EWA Water Purchase.xls spreadsheet post-processing tool was developed to compute the magnitude and timing of potential EWA actions. Development of this tool was necessary because the CALSIM II model is presently incapable of simulating the range of EWA actions contemplated for the Flexible Purchase Alternative evaluated in the EWA EIS/EIR. Results obtained using EWA Water Purchase.xls post processing tool were then used in the EWA Routing.xls post processing tool. (Refer to Section 2.1.4.)

The EWA Water Purchases.xls spreadsheet post-processor tool was utilized to perform the following functions:

- Redistribute SWP and CVP Delta exports during July, August, and September;
- Identify EWA Delta export volumes for July, August, and September;
- Identify EWA upstream from the Delta water sources used for exports;
- Perform an initial upstream from the Delta routing to check operational constraints; and
- Identify carriage water requirements associated with the EWA actions.

These functions are described in greater detail in the following sections.

2.1.3.1 Redistribution of State Water Project/Central Valley Project Delta Exports

The CALSIM II simulation results include Delta export operations at the Banks and Tracy pumping plants. An examination of the pattern of SWP/CVP exports during the summer months (July through September) shows a model preference for using nearly all of the available Delta export capacity in September with decreasing usage in August and July. This export pattern makes it difficult or, in some cases, impossible to export EWA assets that are available in August and September. For example, EWA assets obtained from crop idling in August and September would be unusable by the EWA program if the water cannot be exported in those same months. Similarly, use of water assets obtained from groundwater substitution or surface water purchases would be limited to those months when Delta export capacity is available to the EWA Program at the Projects' pumps.

The EWA Water Purchase.xls Tool was utilized to redistribute SWP/CVP summer exports during the July through September period to provide for use of EWA assets throughout these months. This redistribution assumed that the total amount of SWP/CVP exports for the summer would not be altered from the amount in the CALSIM II simulation results (referred to as the unaltered condition) and that DWR and Reclamation would cooperatively resolve any issues that arise related to SWP/CVP Coordinated Operations Agreement (COA) responsibilities, as is done on a regular basis under current practices.

Because the redistribution of SWP/CVP Delta exports over the summer months would alter the timing of releases from upstream Project reservoirs, control was maintained on maximum and minimum releases. Redistribution of exports was not allowed to increase Keswick releases above 15,000 cubic feet per second (cfs), Oroville releases above 12,000 cfs, and Nimbus releases above 5,000 cfs. Minimum releases from the Project reservoirs were identified as those necessary for instream environmental requirements or diversion (Wilkins Slough). In the post processor tool, releases from the Project reservoirs for the summer period were temporally altered in response to the redistribution of exports, but were in total volume no more or less than under the "unaltered condition". In real-time, however, DWR and Reclamation operators would have to approve this type of operation on a case-by-case basis.

2.1.3.2 EWA Delta Export Volumes (July through September)

Subsequent to the redistribution of SWP/CVP exports, the EWA Water Purchase.xls tool was used to determine the amount of export capacity available for EWA assets. These calculations were based on the unused Banks and Tracy pumping plant capacities and allowable E/I ratio, as described below.

The initial determination of export capacity available for EWA asset water was calculated for the Tracy Pumping Plant as the difference between the monthly CVP export (average flow rate) and the pumping plant capacity, 4,600 cfs. At the Banks Pumping Plant, the initial export capacity available for EWA asset water was calculated as half of the difference between the monthly SWP export (average flow rate) and the authorized pumping plant capacity, 6,680 cfs**,** plus, the EWA variable asset, 500 cfs. In instances where CVP pumping at the Banks Pumping Plant did not require half of the difference, the unused share of this capacity was available for EWA use (see EWA EIS/EIR, Chapter 2, Relaxation of the Section 10 Constraint).

SWP/CVP exports from the Delta are subject to restrictions imposed by the E/I ratio. EWA exports were assumed to comply with this ratio; therefore in some months, available EWA exports were further limited (or controlled) by the E/I ratio. Because increasing EWA exports above the E/I ratio to 0.65 during the July to September period would incur an immediate 35 percent (1.00 - 0.65) loss in EWA water entering the Delta, there was no attempt to maximize EWA exports with the E/I ratio controlled.

2.1.3.3 EWA Upstream from the Delta Region Water Sources

Potential upstream from the Delta EWA assets are described in Chapter 2 of the EWA EIS/EIR. Identifying the location, amount, and type of potential individual water purchases in the Upstream from the Delta Region is critical to determining the instream flow, water temperature, reservoir storage change, and potential water quality effects of the EWA Program. There are numerous possible combinations of water purchases in the Upstream from the Delta Region. Multiple studies to analyze all of the combinations were not feasible because of the time and cost of such an effort.

Because the assets are of varying quantity and type (surface water supplies and/or groundwater supplies), priorities should be assigned to the assets based on the ability of the source to effectively correspond with the temporal EWA export capability. To that end, as listed below, surface water supplies generally were given high priority because of their ability to be used at nearly any time; groundwater substitution supplies were assigned the next highest priority, and supplies made available from crop idling was given the lowest priority. In many years, some portion of all of the available asset types were used in order to maximize the amount of EWA export water.

The EWA agencies prioritized the types and amounts of water purchases in the Upstream from the Delta Region, as follows:

- Water will be purchased first from the Upstream from the Delta Region, limited by the available SWP and CVP export capacity, and second from sellers in the Export Service Area.

- Purchases from reservoir storage will be used before any other purchase option is pursued.

- Stored groundwater purchases will be pursued as a second option after all reservoir storage purchases have been utilized.

- Groundwater substitution purchases will occur if more water were needed than can be obtained from reservoir storage and stored groundwater purchases.

- Water purchases obtained from idling rice will be pursued as a final option if more water were required to satisfy EWA requirements.

- Idling rice in the Feather River Basin will be pursued before idling rice in the Sacramento River Basin because some water from Sacramento River purchases could not be stored in Lake Shasta during April, May, and June when instream water temperature obligations require the water to be released.

2.1.3.4 Upstream from the Delta Region EWA Water Routing

Once the Upstream from the Delta Region EWA assets were selected and total quantity assumed for the specific analysis for a given month, the water was routed through the system of reservoirs and rivers conveying the water to and through the Delta. This routing imposed the appropriate operational constraints and allowed for the computation of changes in reservoir storage resulting from the proposed EWA operations. Physical system limitations were complied with in all months that EWA assets were acquired or used.

<u>Oroville Reservoir Storage</u>

The following discussion on reservoir storage is specific to Oroville Reservoir and is presented to illustrate why there are monthly operational changes in upstream reservoirs caused by EWA purchases. A similar discussion would describe the conditions at Shasta Reservoir, although the actual net changes in reservoir storage would be less.

CVP/SWP monthly reservoir operations would be altered by the implementation of the EWA Flexible Purchase Alternative. Exactly how the reservoirs would be affected is a function of the monthly pattern of CVP/SWP Delta exports, which in turn dictates the availability of monthly export capacity for the EWA.

CALSIM II modeling of the Baseline Condition favors SWP Delta export pumping in September with less reliance on export pumping in August and July. Oroville releases for SWP export pumping also uses the same export-pumping pattern. As a consequence of the timing of releases for SWP export pumping, Oroville storage remains higher in July and August than it would be if SWP export pumping (and consequently releases) occurred more evenly throughout July through September.

To illustrate differences in monthly Oroville storage associated with alternative timing of SWP exports, the CALSIM II Baseline Condition simulation was post-processed to simulate a more even distribution of SWP exports from July through September. This post-processing did not alter the total July through September SWP export volume; it only changed the monthly pattern of export pumping. In the following discussion, this post-processed simulation is referred to as the “Alternative (Alt) Baseline.”

Figure 2 illustrates the average Oroville end-of-month storage for the 1922-1993 modeling period for the Baseline Condition, Alt Baseline, and Flexible Purchase Alternative simulations. The end of June reservoir storages for the Baseline and Alt Baseline are identical as are the end of September storages for the Baseline and Alt Baseline. Only the July and August storages differ between these simulations, reflecting the alternative SWP Delta export patterns. As Figure 2 shows, SWP export pumping in September under the Baseline Condition simulation results in higher Oroville storage during July and August.

Also shown in Figure 2 is a trace of Oroville storage from the EWA Flexible Purchase Alternative simulation. This trace shows that Oroville storage at the end of June is higher than both of the Baseline and Alt Baseline Conditions simulations because of the preservation of water from idled lands in months prior to July. In July and August, the Oroville storage under the Flexible Purchase Alternative falls below the Baseline Condition storage but is higher than the "Alt Baseline" storage. By the end of September, Oroville storage is essentially identical for all three simulations.

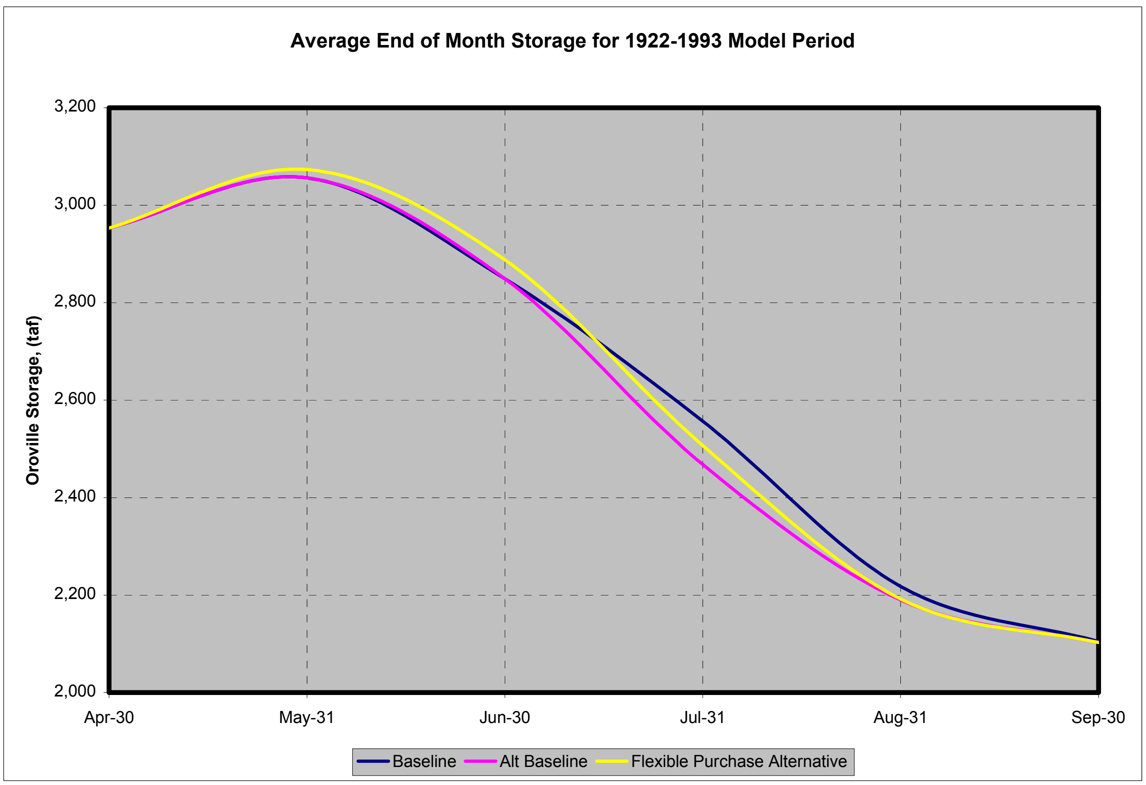

Figure 2 Average Oroville End-of-Month Storage for the 1922-1993 Model Period

Figure 3 illustrates the pattern of end-of-month water use by those entities idling land in the Feather River Region for the purpose of EWA sales. The general agricultural water use pattern, without the EWA, is shown in the Figure 3 as Pre EWA Use. The Flexible Purchase Alternative in Figure 3 shows the water use pattern with EWA actions. The chart shows the periods when water purchased by the EWA would be released into the rivers. As shown in Figure 4, by the end of July and continuing through August, the cumulative (agriculture and EWA) water use by the Flexible Purchase Alternative exceeds the typical agricultural water use. However, agricultural water use (Pre EWA use) is greater than the Flexible Purchase Alternative use in September and the cumulative volume difference in water use of the purchased water nets to zero by the end of September.

In the instance of the Alt Baseline, there is a presumption that the SWP will alter its Delta export pumping from that assumed in the CALSIM II Baseline Condition simulation. If this is true, then the Flexible Purchase Alternative operation would result in comparatively higher Oroville reservoir storage in July and August. Alternatively, if the SWP maintains the pattern of Delta exports assumed in the Baseline Condition simulation, the Flexible Purchase Alternative would cause lower Oroville reservoir storage in July and August. The Project operators would determine if this pattern of use were acceptable on a real-time case-by-case basis.

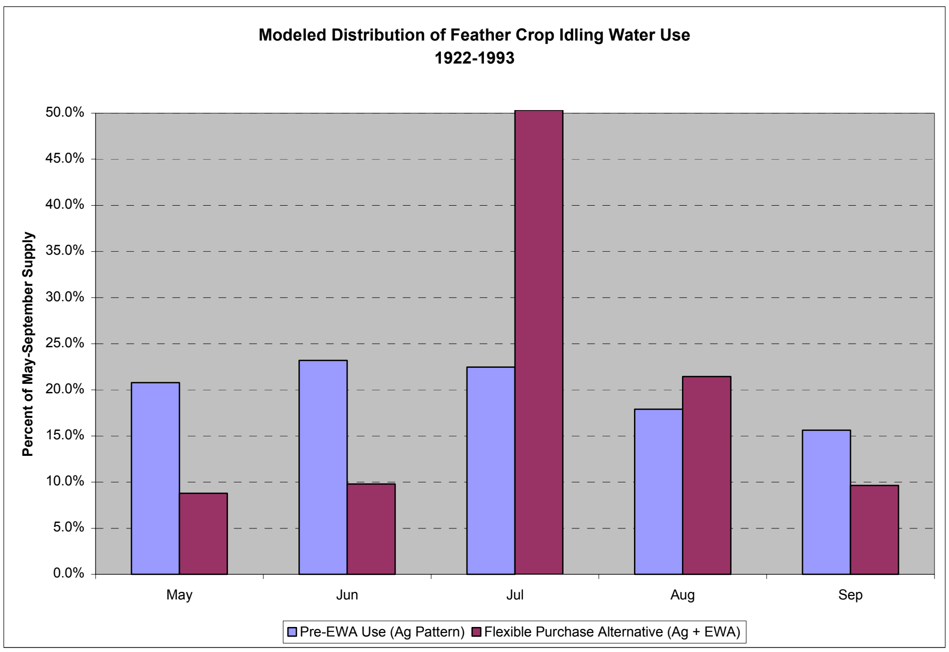

Figure 3
Modeled Distribution of Feather River Crop Idling Water Use (1922-1993)

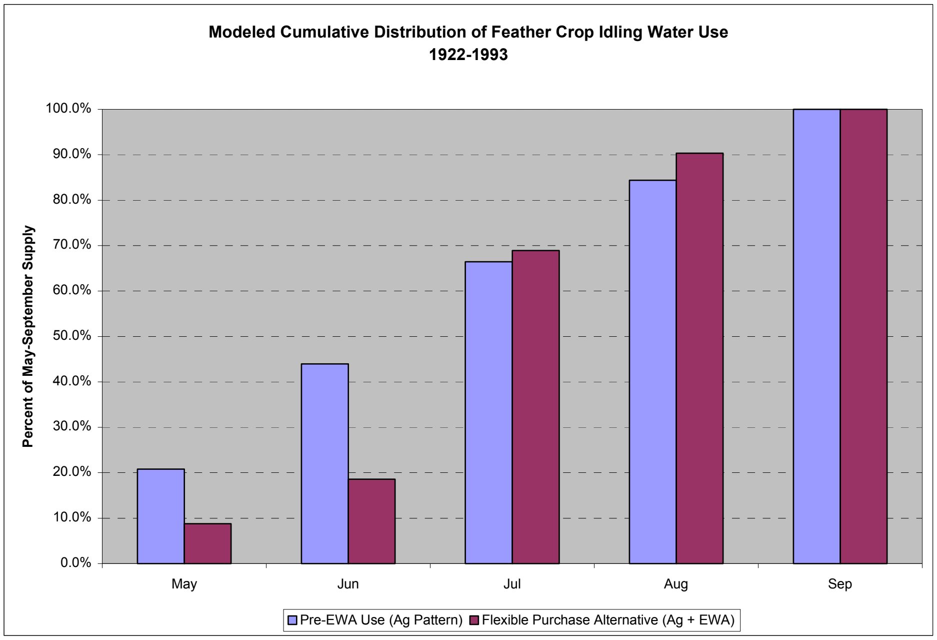

Figure 4
Modeled Cumulative Distribution of Feather River Crop Idling Water Use (1922-1993)

In order to not preclude any future operational flexibility by the SWP, it was determined that the EWA EIS/EIR should not suggest any change in the Baseline Condition during the July through September Project exports (no redistribution of SWP and CVP exports) presented in the CALSIM II simulation, which was provided by DWR. This determination is consistent with the full disclosure of potential effects of the proposed action and does not impose an obligation on the SWP to alter its own characterization of SWP operations. Also, throughout the analyses presented in the EIS/EIR, an assumption is made that presenting the worst-case condition is most defensible in identifying effects of the proposed action. In view of this conservative assumption, the effect of the Flexible Purchase Alternative on reservoir storage is identified as the comparison of the Flexible Purchase Alternative to the Baseline Condition. This assumption acknowledges worst-case conditions caused by the Flexible Purchase Alternative on reservoir fisheries and recreation.

2.1.3.5 Carriage Water

Exporting additional water from the Delta can adversely affect water quality in the Delta; therefore; the EWA routing procedure was developed to account for upstream river flows and Delta operations. Because additional Delta exports can have an adverse effect on water quality in the Delta, the routing procedure reflects the influence of increased exports on water quality. Carriage water is the term used for the amount of additional water assumed to be required as increased Delta inflow and outflow to maintain water quality standards in the Delta. Estimated carriage water costs associated with EWA exports range between 15 percent and 35 percent of the EWA share of Delta inflow. In application, if EWA exports were 150 TAF or less in a given month, EWA exports would be 85 percent (100 percent – 15 percent = 85 percent) of purchases, with the excess purchase going to Delta outflow. This percentage varied to 65 percent (100 percent – 35 percent = 65 percent) in months when the EWA export was greater than 400 TAF.

Carriage water is included in the EWA asset purchases and routed through the reservoir and river system in the same manner.

2.1.3.6 EWA Water Purchases.xls Post Processing Tool Output

The EWA Water Purchases.xls post processing tool provides the following output:

- Revised Shasta, Oroville, and Folsom storage;
- Revised flows for the Sacramento River at Keswick Reservoir, Feather River at Oroville Dam, and American River at Nimbus Reservoir;
- Revised flows for the Yuba River basin, Feather River basin, and Sacramento River basin; and
- Revised total Delta exports.

These outputs were then used in the EWA Routing.xls Tool (refer to Section 2.1.4) to produce the final "virtual" CALSIM II output database for use in the effect assessment.

2.1.4 EWA Routing.xls Post Processing Tool

This tool was developed to take the results of the CALSIM II Baseline Condition simulation and the EWA Water Purchases.xls tool (refer to Section 2.1.3), simulate or "route" the output (reservoir storage, releases, instream flows, etc.) through the Project system, and provide output (results) for a "virtual" CALSIM II output database.

The EWA Routing.xls tool has several basic functions:

- Final upstream of Delta Routing;
- Implementation of EWA fish actions in December through July;
- Final implementation of export shifting and additional EWA exports in July through September;
- Split of total Delta export into CVP and SWP exports (Tracy and Banks pumping plants);
- Full Delta routing; and
- "Virtual" CALSIM II output development.

2.1.4.1 Upstream from the Delta Routing

The EWA Routing.xls post processing tool involved determining and assigning the EWA assets to individual schematic nodes relative to the CALSIM II structure and calculating how the SWP and CVP system operations would change in response to a list of assumed EWA fish actions. Decisions were made regarding the location within a particular river basin (node) where individual fish actions would first influence system operations. Then, the initial results (reservoir storage, dam releases, and stream flows) from the CALSIM II benchmark study were recomputed from that location throughout the system upstream of the Delta. These assumptions are provided in Table 1. As shown in Table 1, the EWA asset actions that would take place within the Sacramento River Basin were split between two different nodes, 118 and 129.

Table 1
Assignment of EWA Asset Actions to CALSIM II Nodes

Description/EWA Asset Location	CALSIM Schematic Node
Shasta Reservoir Storage	4
Keswick Reservoir Release	6
Sacramento River Basin Assets (50 percent)	118
Sacramento River Basin Assets (50 percent)	129
Oroville Reservoir Storage	6
Oroville Reservoir Release	6
Yuba River Basin Assets	211
Feather River Basin Assets	223
Folsom Reservoir Storage	8
Nimbus Reservoir Release	9[a]
Lake McClure Storage	20
Lake McClure Release	20

[a] Includes flow modification upstream to Folsom (Node 8).

2.1.4.2 *Split of Total Delta Export Into CVP/SWP Exports*

An intermediate step made by this tool evaluated and redistributed the total Delta exports relative to the CALSIM II Baseline Condition simulation results. During the summer months, if the total Delta export result obtained through post-processing was greater than the result in the CALSIM II Baseline Condition, the additional export amount was assigned first to the CVP Tracy Pumping Plant (up to a maximum of 4,600 cfs), then any remaining amount was assigned to the SWP Banks Pumping Plant. If the total Delta export result obtained through post-processing was less than the CALSIM II Baseline Condition simulation (e.g., winter/spring export curtailment months), then the baseline export values were recalculated. Reductions in exports were first applied to the SWP Banks Pumping Plant (maintaining a minimum diversion of 750 cfs), then any additional reductions were imposed at the CVP Tracy Pumping Plant.

2.1.4.3 *Delta Routing*

A final routing of the Delta was then done using Delta inflow values from the upstream routings and the final exports. Revised Delta Cross Channel flows, X2 location, and QWEST values were computed from the final routed values.

2.1.4.4 *"Virtual" CALSIM II Output Creation*

The EWA Routing.xls post processing tool was then used to create a "virtual" CALSIM II output database. This was accomplished by copying the CALSIM II baseline output database and saving the newly recomputed storages, flows, and exports from the spreadsheet into the database. This produces a CALSIM II output database with all revised values in it, which to the other post-processor tools appears to have come directly from a CALSIM II simulation. This allows other tools designed to work with CALSIM II simulation output to be used for output analysis and linkage to other models without modification.

2.1.5 Water Temperature Models

Reclamation has developed water temperature models for the Sacramento, Feather, and American Rivers. The models have both reservoir and river components to simulate water temperatures in five major reservoirs (Trinity, Whiskeytown, Shasta, Oroville, and Folsom); four downstream regulating reservoirs (Lewiston, Keswick, Thermalito, and Natoma); and three main river systems (Sacramento, Feather, and American).

These temperature models were designed to estimate water temperatures that would occur for conditions simulated by PROSIM, a Reclamation-developed operation model that is a predecessor to the CALSIM II model. They are used to assess changes in average monthly water temperature caused by changes in CVP/SWP operations. A spreadsheet post-processor tool was developed to allow use of CALSIM II-computed reservoir storage and stream flows to generate the required water temperature model inputs. There were no internal changes to any of the water temperature models.

The PROSIM operations model used a time period of 70 years from 1922 to 1991. Because the water temperature models were designed to operate using PROSIM results, and they operate on a calendar year, rather than on a water year basis, the period of record is 1922 to 1990 (69 years). Extension of the water temperature models to fully cover the CALSIM II time period of 1922 to 1993 (72 years) would have required extensive data development and model calibration effort and was not performed for this analysis.

Sections 2.1.5.1 and 2.1.5.2 provide additional detail regarding the reservoir and river components of the water temperature models, respectively. Additional details regarding Reclamation's water temperature models are well documented in the CVPIA *Draft Programmatic EIS (PEIS) Technical Appendix, Volume Nine*. These temperature models also are documented in the report titled: *U.S. Bureau of Reclamation Monthly Temperature Model Sacramento River Basin*, June 1990.

2.1.5.1 Reservoir Water Temperature Component

Reclamation's reservoir models simulate monthly water temperature profiles in five major reservoirs: Trinity, Whiskeytown, Shasta, Oroville, and Folsom. Vertical water temperature profile in a reservoir is simulated in one dimension using monthly storage, inflow and outflow water temperature and flow rate, evaporation, precipitation, solar radiation, and average air temperature. The models also compute the water temperatures of dam releases. Release water temperature control measures in reservoirs, such as the penstock shutters in Folsom Reservoir, the temperature control device in Lake Shasta, and the temperature curtains in Whiskeytown Reservoir are incorporated into the models.

Reservoir inflow, outflow, and end-of-month storage content as calculated by CALSIM II are input to the reservoir water temperature models. Additional input data include meteorological information and monthly water temperature targets that are used by the model to select the level from which reservoir releases are drawn. Model output includes water temperature at each level in the reservoir as well as temperature of the reservoir release. The reservoir release temperature is then used in the downstream river water temperature model, as described in the next section.

2.1.5.2 River Water Temperature Component

Reclamation's river water temperature models utilize the calculated temperatures of reservoir release, much of the same meteorological data used in the reservoir models (described in Section 2.1.5.1), and CALSIM II output on river flow rates, gains and diversions. Mean monthly water temperatures are calculated at multiple locations on the Sacramento, Feather, and American Rivers.

Release rate and water temperature of regulating reservoir storage serve as the boundary conditions for the river water temperature model. The river temperature model computes water temperatures at 52 locations on the Sacramento River from Keswick Dam to Freeport, and at multiple locations on the Feather and American Rivers. The river temperature model also calculates water temperature within Lewiston, Keswick, Thermalito, and Natoma Reservoirs. This model is used to simulate water temperatures in these reservoirs because they are relatively small bodies of water with short residence times; thereby, on a monthly basis, the reservoirs act as if they have physical characteristics approximating those of riverine environments.

2.1.5.3 Automated Temperature Selection Procedure

The Folsom Reservoir and lower American River water temperature model components are utilized in an iterative manner referred to as the Automated Temperature Selection Procedure (ATSP). This procedure operates the reservoir and river water temperature models with the objective of achieving monthly target temperatures in the lower American River at Watt Avenue. The target water temperatures have been set by qualified fisheries biologists who have determined a range of water temperatures that are the most biologically favorable to the fish species that are present in the river, at any given time of year. Targets are achieved through a choice of reservoir levels from which the release is drawn. This modeling procedure is conducted for the purpose of allowing the most optimal utilization of the available coldwater pool in Folsom Lake and to ensure that the species-specific needs of anadromous fish in the river are met over the course of the entire year.

2.1.5.4 Folsom Reservoir Model Code Modifications

The Folsom Reservoir water temperature model component was modified to simulate a Temperature Control Device (TCD) for the Folsom Dam Pumping Plant. The TCD has been authorized by Congress and is expected to be in place in the next few years. The TCD was incorporated into the model by defining numerous levels from which Folsom Dam diversions could occur. The TCD is operated to maximize the use of warm water; thus, the diversion level is set as close to 25 feet below the reservoir water surface as possible.

2.1.6 Salmon Mortality Models

Water temperatures calculated for specific reaches of the Sacramento and American Rivers are used in Reclamation’s Chinook salmon mortality models to estimate annual percentage mortality of early-lifestage Chinook salmon. Reclamation’s Chinook salmon mortality models produce a single estimate of early life stage Chinook salmon mortality for each year of the simulation. This estimate consolidates calculations of salmon mortality for three separate early-life stages 1) pre-spawned eggs; 2) fertilized eggs; and 3) pre-emergent fry. For the Sacramento River, the model computes mortality for each of the four Chinook salmon runs: fall, late-fall, winter, and spring. For the American River, the model produces estimates of fall-run Chinook salmon mortality only. The mortality estimates are based on output temperatures from Reclamation’s water temperature models. Temperature units (TUs), defined as the difference between river temperatures and 32°F, are accounted for on a daily basis by the mortality model, and are used to track life-stage development. For example, incubating eggs exposed to 42°F water for one day would experience 10 TUs. Eggs are assumed to hatch upon exposure to 750 TUs following fertilization. Similarly, the salmon mortality model assumes that fry emerge from the gravel after being exposed to 750 TUs following egg hatching into the pre-emergent fry stage.

2.1.7 Graphic and Tabular Analysis of Environmental Resources (GATAER) Tool

The GATAER tool produces figures and tables for the analysis of output from CALSIM II, the water temperature models, salmon mortality models, and other post-processing applications. Data is loaded from these models into a DSS database, which is then used as input to a series of spreadsheets, which generate the figures and tables for environmental resource analyses. The figures and tables generated for the evaluations of specific resource areas are included in Appendix H of the EWA EIS/EIR.

2.1.8 Delta Simulation Model II (DSM2)

DSM2 is the Delta hydrodynamic and salinity model currently in use by DWR. The model is capable of simulating physical conditions in riverine systems and estuaries, and the effects of land-based processes (agricultural runoff and consumptive use). These wide-ranging capabilities make it a valuable tool for analyzing the potential effects of proposed EWA actions in the Delta.

The hydrodynamic module simulates the channel flows, velocities, and water surface elevations in the Bay-Delta estuary. The water movement information developed by the hydrodynamic module is then used as input into the other two modules (water quality and particle-tracking), which can be used to determine the movement of constituents. The water quality module calculates the changes in water quality (primarily salinity) resulting from different source water qualities and from the mixing caused by water movement throughout the system. The particle-tracking module is used to evaluate mass transport processes.

DSM2 can calculate stages, flows, velocities, and many mass transport processes, including salts, multiple non-conservative constituents, and water temperature, and individual particles. For the EWA EIS/EIR, results from the EWA Routing.xls post processing tool (Section 2.1.4) provided input for the calculation of Delta export salinity and water level changes caused by the EWA actions.

Additional information on DSM2 model and documentation is publicly available from the DWR, Bay-Delta Office, Modeling Support Branch web site. A detailed discussion of the model and its assumptions are contained at this location: http://modeling.water.ca.gov/delta/models/dsm2/documentation.html.

2.1.9 Application of Hydrologic Modeling Output

The models and post-processing tools used in this analysis have been developed for comparative planning purposes, rather than for predicting actual reservoir or river conditions at specific locations at specific times. The 72-year and 69-year periods of record for CALSIM II and water temperature modeling, respectively, provide an index of the kinds of changes that would be expected to occur with implementation of a specified set of operational conditions. Reservoir storage, river flows, water temperature, and salmon mortality output for the period modeled should not be interpreted or used as definitive absolutes depicting actual conditions that will occur in the future. Rather, output for the Proposed Action can be compared to output for the basis of comparison to determine:

- Whether reservoir storage or river flows and water temperatures would change with implementation of the alternative;

- The months in which potential reservoir storage and river flow and water temperatures changes could occur; and

- A relative index of the magnitude of change that could occur during specific months of particular water year types, and whether the relative magnitude would result in effects on aquatic resources within the area studied.

The models used, although mathematically precise, should be viewed as having reasonable detection limits. Establishing reasonable detection limits is useful to those using the modeling output for effect assessment purposes, and prevents making inferences beyond the capabilities of the models and beyond an ability to actually measure changes. Although data from the models are reported to the nearest 1) 1,000 acre-feet in reservoir storage; 2) foot in water surface elevation; 3) cubic foot per second in river flow; 4) 0.1 °F in water temperature; and 5) tenth of a percent in salmon mortality, these values were rounded when interpreting differences for a given parameter between two modeling simulations. For example, two simulations having river flows at a given location within one percent of each other were considered to be essentially equivalent (represent no measurable change). Because the models provide reservoir storage data on a monthly time-step, measurable differences in reservoir storage were evaluated on a similar basis. Similar rounding of modeled output was performed for other output parameters as well in order to assure the reasonableness of the effect assessments.

In-situ temperature loggers were used to collect water temperature data used for the model. These loggers typically have a precision of +/-0.36 °F, yielding a potential total error of 0.72 °F (Sacramento River Temperature Modeling Project 1997). Therefore, modeled differences in water temperature of 0.36 °F or less could not be consistently detected in the river by actual monitoring of water temperatures. In addition, as mentioned above, output from Reclamation's water temperature models provides a relative index of water temperatures under the various operational conditions modeled. Output values indicate whether the water temperatures would be expected to increase, remain unchanged, or decrease, and provide insight regarding the relative magnitude of potential changes under one operational condition compared to another. For the purposes of the EWA effect assessment, modeled water temperature changes that were within 0.3 °F between modeled simulations were considered to be essentially equivalent. A level of detection of measurable change of 0.3 °F was used because 1) model output is reported to 0.1 °F; 2) rounding the level of error associated with in-situ temperature loggers used for model temperature data up to 0.4 °F would eliminate the possibility of detecting measurable change between 0.36 °F and 0.4 °F; and 3) rounding the level of detection down to 0.3 °F is the more conservative approach in detecting a change in temperature between the modeling results. Temperature differences between modeling results of more than 0.3 °F were assessed for their biological significance. This approach is considered very rigorous, because it utilizes a more conservative threshold of detection for potential water temperature changes than used in other fisheries effect assessments. For example, USFWS and Reclamation, in the Trinity River Mainstem Fishery Restoration Draft EIS/EIR (USFWS *et al*. 1999), used a change in long-term average water temperature of 0.5 °F as a threshold of significance, and the Central Valley Regional Water Quality Control Board generally uses a change of 1.0 °F as a threshold of significance.

2.2 Model Simulations and Assumptions/Effect Analysis Approach

Modeling simulations were developed to evaluate potential environmental effects of the Proposed Action (Flexible Purchase Alternative). Because there are no other known foreseeable State or private actions that would be implemented during the period of time defined by the EWA Program (2000-2007), a separate cumulative modeling run was not performed. Conditions under the cumulative condition would be the same as those that were modeled under the Proposed Action.

The development of the modeling simulations and consideration of available information or data resulted in the development of two different approaches to model and evaluate Upstream from the Delta Region and Delta Region effects of the Proposed Action on aquatic resources. These two approaches are described in the following sections.

2.2.1 Upstream from the Delta Region

The hydrologic analysis performed for the Upstream from the Delta Region includes the CVP and SWP facilities on the Sacramento River (Shasta Reservoir, Keswick Reservoir), Feather River (Lake Oroville), and American River (Folsom Reservoir). The Delta Region analysis is evaluated with a separate set of simulations and assumptions as described in Section 2.2.2.

2.2.1.1 Upstream from the Delta Region – Basis of Comparison Simulation

The CALSIM II benchmark study (BST_2001D10A_ANNBENCHMARK_1_2_B2_7-23-2002) was used as the basis for all hydrologic modeling presented in the EWA EIS/EIR. As described earlier, the CALSIM II simulation utilized the wrapper representing D-1485 through CVPIA b(2) regulatory constraints.

CALSIM II documentation is publicly available from the DWR, Bay-Delta Office, Modeling Support Branch web site. A detailed discussion of the model and its assumptions are contained in the document entitled "BST_2020D09D_ANNBENCHMARK_2_2, Benchmark Studies Assumptions and Appendices." This document includes the assumptions for the CALSIM II 2001 benchmark study (BST_2001D10A) identified above.

The basis of comparison simulation represents the hydrologic conditions within the CVP/SWP system prior to CALFED Record of Decision (ROD) and implementation of the EWA Program (prior to 2001). As discussed in Chapter 2 of the EWA EIS/EIR, the No Action/No Project Alternative conditions are represented by the Baseline Condition. The simulation includes surface water diversion and operation practices and policies (such as minimum instream flows, flood control, and Delta water quality standards) of the CVP/SWP and assumptions associated with accretion and depletions from the system that incorporate the exercise of water rights by non-CVP/SWP users.

The modeling assumptions incorporated into the CALSIM II benchmark study and utilized in further development of the Baseline Condition simulation are summarized in Table 2. More detailed descriptions of these assumptions follow the table.

Table 2
EWA Modeling Assumptions Included in the CALSIM II Benchmark Study

Parameter	***Benchmark Study Assumption***
PERIOD OF RECORD	1922-1993 (72 years)
HYDROLOGY	
Level of Land Use	2001 Level, DWR Bulletin 160-98[1] 2020
DEMANDS	
North of Delta (excluding American River)	
CVP	Land Use based, limited by Full Contract
SWP (FRSA)	Land Use based, limited by Full Contract
non-Project	Land Use based
CVP Refuges	Firm Level 2
American River Basin Water Rights CVP	 2001[2] 2001[2]
San Joaquin River Basin Friant Unit Lower Basin Stanislaus River Basin	 Regression of historical Fixed annual demands New Melones Interim Operations Plan
South of Delta	
CVP	Full Contract
Contra Costa Water District	140 TAF/YR[3]
SWP (w/ North Bay Aqueduct)	3.0-4.1 MAF/YR
SWP Article 21 Demand	MWDSC up to 50 TAF/month, Dec-Mar, others up to 84 TAF/month
FACILITIES	**Existing Facilities (2001)**
RESERVOIR REFILL CRITERIA	Annual refill occurs
REGULATORY STANDARDS	
Trinity River	
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF/YR)
Trinity Reservoir End-of-September Minimum Storage	Trinity EIS Preferred Alternative (600 TAF as able)
Clear Creek	
Minimum Flow below Whiskeytown Dam	Downstream water rights, 1963 USBR Proposal to USFWS and NPS, and USFWS discretionary use of CVPIA 3406(b)(2)
Upper Sacramento River	
Shasta Lake End-of-September Minimum Storage	SWRCB WR 1993 Winter-run Biological Opinion (1900 TAF)
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control, and USFWS discretionary use of CVPIA 3406(b)(2)
Feather River	
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement; (600 cfs)
Minimum Flow below Thermalito Afterbay outlet	1983 DWR, DFG Agreement; (1000 – 1700 cfs)
Yuba River	
Minimum Flow below Englebright Dam (as measured at the Marysville and Smartville gauging stations)	2001 SWRCB decision D-1644; Interim (100-1500)
American River	
Minimum Flow below Nimbus Dam	SWRCB D-893 (see accompanying Operations Criteria), and USFWS discretionary use of CVPIA 3406(b)(2)
Minimum Flow at H Street Bridge	SWRCB D-893
Lower Sacramento River	
Minimum Flow near Rio Vista	SWRCB D-1641
Mokelumne River	
Minimum Flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement); (100 – 325 cfs)
Minimum Flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement); (25 – 300 cfs)
Stanislaus River	
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement, and USFWS discretionary use of CVPIA 3406(b)(2)
Minimum Dissolved Oxygen	SWRCB D-1422

Table 2
EWA Modeling Assumptions Included in the CALSIM II Benchmark Study

Parameter	Benchmark Study Assumption
Merced River	
Minimum Flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180 – 220 cfs, Nov – Mar), and Cowell Agreement;
Minimum Flow at Shaffer Bridge	FERC 2179; (25 – 100 cfs)
Tuolumne River	
Minimum Flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94 – 301 TAF/YR)
San Joaquin River	
Maximum Salinity near Vernalis	SWRCB D-1641
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement
Delta Outflow Index (Flow and Salinity)	
Delta Cross Channel Gate Operation	SWRCB D-1641
Delta Exports	SWRCB D-1641, USFWS discretionary use of CVPIA 3406(b)(2), and CALFED Fisheries Agencies discretionary use of EWA
OPERATIONS CRITERIA	
Upper Sacramento River	
Flow Objective for Navigation (Wilkins Slough)	Discretionary 3,500 – 5,000 cfs based on Lake Shasta storage condition
American River	
Folsom Dam Flood Control	SAFCA, Interim-Reoperation of Folsom Dam, Variable 400/670 (without outlet modifications)
Flow below Nimbus Dam	Discretionary operations criteria corresponding to SWRCB D-893 required minimum flow
Sacramento Water Forum Mitigation Water	None
Stanislaus River	
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan
San Joaquin River	
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program
System-wide	
CVP Water Allocation	
CVP Settlement and Exchange	100% (75% in Shasta Critical years)
CVP Refuges	100% (75% in Shasta Critical years)
CVP Agriculture	100% - 0% based on supply (reduced by 3406(b)(2) allocation)
CVP Municipal & Industrial	100% - 50% based on supply (reduced by 3406(b)(2) allocation)
SWP Water Allocation	
North of Delta (FRSA)	Contract specific
South of Delta	Based on supply; Monterey Agreement
CVP/SWP Coordinated Operations	
Sharing of Responsibility for In-Basin-Use	1986 Coordinated Operations Agreement
Sharing of Surplus Flows	1986 Coordinated Operations Agreement
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D-1641; use of CVPIA 3406(b)(2) only restricts CVP exports; EWA use restricts CVP and/or SWP as directed by CALFED Fisheries Agencies
CVPIA 3406(b)(2)	
Allocation	800 TAF/YR (600 TAF/YR in Shasta Critical years)
Actions	1995 WQCP (non-discretionary), Fish flow objectives (Oct-Jan), CVP export reduction (Dec-Jan), VAMP (Apr 15- May 16) CVP export restriction, 3000 cfs CVP export limit in May and June (D1485 Striped Bass continuation), Post (May 16-31) VAMP CVP export restriction, Ramping of CVP export (Jun), Pre (Apr 1-15) VAMP CVP export restriction, CVP export reduction (Feb-Mar), Upstream Releases (Feb-Sep)

Table 2
EWA Modeling Assumptions Included in the CALSIM II Benchmark Study

Parameter	Benchmark Study Assumption
Accounting Adjustments	Per February 2002 Interior Decision, no limit on responsibility for non-discretionary D1641 requirements, no Reset with the Storage metric and no Offset with the Release and Export metrics

1 2001 Level of Development defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from DWR Bulletin 160-98.
1 1998 Level Demands defined in Sacramento Water Forum's EIR with a few updated entries.
2 Delta diversions include operations of Los Vaqueros Reservoir operations.

Period of Record

The period of record used in the hydrologic modeling (CALSIM II) extends from October 1922 through September 1993 (72 years). The period of record used for water temperature modeling and the associated simulations for early lifestage Chinook salmon mortality extends from 1922 through 1990 (69 years). These periods are considered representative of the natural variation in climate and hydrology experienced in the Central Valley during recent times, and include periods of extended drought, high precipitation and runoff, and variations in-between.

Hydrology/Level of Development

The hydrology used is based on DWR Bulletin 160-98. The assumptions used for land use result from aggregation of historical survey and projected data developed for the California Water Plan Update (Bulletin 160). The Baseline Condition uses a 2001 level of land use, estimated by DWR as a linear interpolation between 1995 and 2020 land uses. Because the timeframe for EWA is relatively short (2001 to 2007) compared to the future condition demands (2020) that are used by the model, there is little variation between 2001 demands and projected 2007 demands. As a result, the hydrology used by CALSIM II for the future condition (2007 system demands) is consistent with 2001 land use and development projections.

Demands

The following sections describe how CALSIM II represents water demands within the system represented by the model.

CALSIM II classifies demands for water diversions as CVP project, SWP project, or non-project demands. CVP project demands are separated into four classes based on contract type: agricultural, municipal and industrial (M&I), Settlement and Exchange contractors, and refuges. Demands also are designated by geographic location: Sacramento River Basin, Feather River Service Area (FRSA), American River Basin, San Joaquin River Basin, Delta, and south of the Delta. Demands may be represented as a time series, varying by month and year, or more simply as twelve repeating monthly values. CVP project demands are modeled based on the conditions that apply to the contract type. SWP demands are simulated as defined and referred to by DWR's Office of Planning.

Demands in the Sacramento River Basin, including the Feather River and American River basins, and the Delta are determined based on land use and vary by month and year according to hydrologic conditions. Demands in the East Side Streams area and San Joaquin River Basin are set to fixed values each year. CVP and SWP demands south of the Delta are based on contract amounts, CVP demands are constant each year, and SWP demands vary depending on a wetness index.

Demands Upstream from the Delta (Excluding the American River Basin)

Demands in the Sacramento River Basin, including the Feather River, are determined based on land use for each Depletion Study Area (DSA). The land use acreage used to develop water demands is based on the indicated LOD. A consumptive use model is used to estimate demands for each DSA.

Demands within each DSA must be disaggregated into CVP and/or SWP project and non-project demands. Project demands are subject to reduced water allocations based on contracts with the CVP and SWP, while non-project demands are satisfied from sources other than the CVP and SWP project facilities. Non-project demands can be associated with senior riparian water rights, groundwater pumping, or private storage projects. Releases from the CVP and SWP system are increased to satisfy project demands, but no additional releases are made to satisfy non-project demands.

Demands in the Sacramento River Basin are divided into project/non-project in CALSIM II using a GIS snapshot of the crop and urban acreage (based on county surveys done in the 1990's). CVP contracts in the Sacramento Valley, excluding the American River Basin, consist of Settlement contracts (approximately 2.2 million acre feet [MAF]) and agricultural service contracts (approximately 460 TAF). The FRSA demands are the only SWP demands north of the Delta. These users are entitled to approximately 1.0 MAF per year (MAF/Yr) diversion from the Feather River. Although diversion requirements for contractors north of the Delta are determined using the consumptive use model based on land use, CALSIM II limits their deliveries to the maximum amount under their contract.

CVP Refuges: Firm Level 2

Firm Level 2, current annual average, national wildlife refuge (NWR) water demands are used for the Sacramento, San Joaquin, and Tulare basins. The refuge demands are consistent with the Reclamation Report On Refuge Water Supply Investigations, Central Valley Hydrologic Basin, California - March 1989, with the exception of East Bear Creek Unit data that is from Reclamation's Draft Refuge Water Supply - Long Term Water Supply Agreements, San Joaquin River Basin - November 2000 (Table 1-1). The refuge water demand quantities presented in Table 3 represent the amount of water required to meet refuge demands at the refuge boundaries (firm) and include conveyance losses.

American River Basin

The Water Forum Agreement provides for surface diversion reductions from the American River in "dry" through "driest" years. "Driest" year diversions are no greater than the "1995 Baseline" defined by the Water Forum participants. A "dry" year is defined as a year in which the forecasted Folsom Unimpaired Inflow for March through November (modeled as March 1 through September 30 plus 60 TAF) is less than 950 TAF. A "driest" year is defined as a year in which the forecasted Folsom Unimpaired Inflow for March through November is less than 400 TAF. A summary of demands for the American River Basin is presented in Table 4.

Table 3 CVP Refuge Water Demand - Firm Level 2			
Location	***Demand***	***Location***	***Demand***
Sacramento Basin	**Total (AF)**	**San Joaquin Basin**	**Total (AF)**
Sacramento NWR Complex		San Luis NWR Complex	
Sacramento NWR	61,867	San Luis Unit	17,800
Delevan NWR	29,267	West Bear Creek Unit	9,609
Colusa NWR	33,333	Kesterson Unit	7,647
Sutter NWR	26,111	Freitas Unit	4,702
Gray Lodge WMA	40,602	Merced Unit	13,500
Modoc NWR	23,752	East Bear Creek Unit	8,863
Total	214,932	Los Banos WMA	13,253
		Volta WA	13,000
		North Grassland WMA	
Tulare Basin	**Total (AF)**	China Island Unit	8,196
Pixley NWR	1,280	Salt Slough Unit	7,859
Kern NWR	11,437	Mendota WMA	27,594
Total	12,717	Grassland RCD	147,059
		Total	279,082
NWR–National Wildlife Refuge; WMA–Wildlife Management Area; WA–Wildlife Area; RCD–Resource Conservation District			

Table 4 American River Basin Demand Summary (TAF/Yr)						
	CVP Agricultural Contracts	***CVP M&I Contracts***	***Water Rights/ non-Project***	***Total***	***Total "Driest" Year***	***Approximate "Driest" Year Reduction***
Total 2001 Level	0	65,850	231,350	297,200	0	0
Total 2020 Level	15,000	180,850	400,850	596,700	450,100	146,600

<u>San Joaquin River Basin</u>

Demands in the San Joaquin River Basin generally are set to fixed annual amounts rather than based on land use and hydrologic conditions as with the Sacramento Valley demands presented above. The operation of the Friant Unit is extracted from a SANJASM model simulation and is not operated in CALSIM II. Table 5 presents average annual diversions and fixed annual demands for projects in the San Joaquin River Basin. These demands are incorporated into the CALSIM II benchmark study used for the EWA EIS/EIR modeling.

<u>Demands South of the Delta</u>

CVP and SWP demands south of the Delta are based on contract amounts; SWP demands vary depending on a wetness index.

CVP South of the Delta

CVP demands south of the Delta include agricultural and M&I needs served from the San Luis Reservoir and San Felipe Unit, the Cross Valley Canal, the Delta-Mendota Canal (DMC) and Mendota Pool. CVP demands south of the Delta are always set to contract amount and do not vary based on hydrologic conditions. These demands also include Exchange Contractors, refuge water supplies and operational losses. CVP demands are aggregated based on contract type and the following geographic locations: Upper DMC, Lower DMC, Mendota Pool, San Felipe Unit, and California Aqueduct.

Table 5 San Joaquin River Basin Demand Assumptions	
Location	**Demand (TAF)**
Friant-Kern Canal*	1,100
Madera Canal to Madera ID*	145
Madera Canal to Chowchilla ID*	98
Madera ID**	386
Chowchilla **	293
Merced ID **	620
Turlock ID **	733
Modesto ID **	417
Tri-dams**	574
*Annual average delivery **Fixed annual demand ID – Irrigation District	

Monthly demand patterns are determined for Exchange, M&I, and agricultural contractors based on recent historical CVP deliveries. Table 6 contains a summary of the total CVP demands south of the Delta, not including refuge demands.

Table 6 CVP South-of-Delta Contract-Based Demands	
Contract Type	**Demand Amount (AF)**
Water Right	40,813
Project Agricultural	1,824,758
Exchange	840,000
M&I	154,150
Losses	183,700
Total	3,043,421

SWP South of the Delta

Twenty-nine agencies have contracts for a long-term water supply from the SWP totaling about 4.2 MAF annually, of which about 4.1 MAF are for contracting agencies with service areas south of the Delta. About 70 percent of this amount is the contract entitlement for urban users and the remaining 30 percent is for agricultural users.

Demands are set in accordance with the Monterey Agreement. They are calculated from the 1996 Table A entitlements. Aqueduct deliveries to San Joaquin Valley agricultural contractors are reduced in wetter years using a wetness index developed from annual Kern River inflows to Lake Isabella. Deliveries to the Metropolitan Water District of Southern California (Metropolitan WD) are reduced in wetter years using the 10-station, two-year average precipitation index or based upon Metropolitan WD integrated operations with Eastside Reservoir in future scenarios.

When available, Article 21 water is delivered to SWP south-of-Delta contractors in accordance with the Monterey Agreement. Article 21 water results from direct diversions from Banks Pumping Plant; it is not stored in San Luis Reservoir for later delivery to contractors. A contractor may accept Article 21 water in addition to its monthly scheduled entitlement water. Article 21 water deliveries do not effect Table A entitlement water allocations. If demand for Article 21 water is greater than supply in any month, the supply is allocated in proportion to the entitlements of those contractors requesting Article 21 water.

CVP and SWP Facilities and Operations

The major water storage and conveyance facilities included in CALSIM II, are identified in Table 7 and Table 8, respectively. Specific criteria have been defined for each of these facilities for incorporation into the model. Criteria include physical characteristics (storage and conveyance capacity), evaporation and loss estimates, regulatory and operational requirements, and incorporation of each facility into the overall system.

Table 7
Major Central Valley Project and State Water Project Storage Facilities Included in CALSIM II

Storage Facility	*Gross Storage Capacity (TAF)*
Sacramento Basin	
Trinity Reservoir	2447
Whiskeytown Reservoir	240
Lake Shasta	4552
Keswick Reservoir	24
Lake Oroville	3558
Thermalito Forebay	12
Folsom Lake	975
Lake Natoma	9
CVP/SWP South-of-Delta	
CVP San Luis Reservoir	972
SWP San Luis Reservoir	1067
Lake Del Valle	77
Silverwood Lake	75
Perris Lake	131
Pyramid Lake	171
Castaic Lake	324
San Joaquin River Basin	
Millerton Lake	521
Hensley Lake	90
Eastman Lake	151
Lake McClure	1024
New Don Pedro Reservoir	2030
New Melones Reservoir	2420
Tulloch Lake	67
New Hogan Reservoir	325
Pardee Reservoir	210
Camanche Reservoir	438

Table 8
Major Central Valley Project and State Water Project Conveyance Facilities Included in CALSIM II

Conveyance Facility	*Conveyance Capacity (cfs)*
Clear Creek Tunnel	3300
Spring Creek Tunnel	4200
California Aqueduct upstream of O'Neill Forebay	10000
California Aqueduct downstream of O'Neill Forebay	13100
California Aqueduct downstream of end of joint use reach	8100
California Aqueduct upstream of Cross Valley Canal	5950
California Aqueduct downstream of Cross Valley Canal	5350
California Aqueduct downstream of Wheeler Ridge Pump Plant	4600
California Aqueduct beginning of East Branch	3149
California Aqueduct beginning of West Branch	3129
San Luis Pumping Plant	11000
Delta Mendota Canal upstream of O'Neill Forebay	4200
Delta Mendota Canal downstream of O'Neill Forebay	3500
Delta Mendota Canal upstream of Delta Mendota Pool	3200

Regulatory Standards

The following sections describe the major CVP and SWP operations and regulatory constraints that are specific to, and occur within, the various regional river basins that are evaluated as part of the modeling applications and hydrologic analyses. These operational and regulatory conditions influence several aspects of water management and availability of water supplies (e.g., conveyance capacities) for the basis of comparison.

Various laws and regulatory decisions provide for protection of environmental conditions. These protections include minimum instream flow requirements, minimum reservoir storage levels, and protection of the Delta against excessive salinity. Specifics regarding these requirements, including references to the regulatory documentation, are provided in the individual resource chapters of the EWA EIS/EIR. As an overview, Table 9 summarizes the locations and applicable regulatory conditions that are either incorporated directly into the model, pre- or post-processing applications, or used as evaluation criteria in interpreting the modeling results.

Table 9
Regulatory Standards and Modeling Applications

Location	Regulatory Standard	Modeling Application
Trinity River/Reservoir	Minimum instream flow requirements Minimum end-of-year reservoir storage	Both incorporated into CALSIM II
Clear Creek	Minimum instream flow requirements below Whiskeytown Reservoir	Incorporated into CALSIM II
Upper Sacramento River	Minimum end-of-year storage in Shasta Lake	Objective evaluated in interpretation of CALSIM II results
	Minimum instream flow requirements below Keswick Dam	Incorporated into CALSIM II
	Navigation flow requirement upstream of City of Sacramento (at Wilkins Slough-navigation control point)	Incorporated into CALSIM II
Feather River	Minimum instream flow requirements	Incorporated into CALSIM II
Yuba River*	Minimum instream flow requirements	Incorporated into CALSIM II
Lower American River	Minimum instream flow requirements (1) below Nimbus Dam and (2) for the reach from Nimbus Dam to the confluence with the Sacramento River	Incorporated into CALSIM II
Lower Sacramento River	Minimum instream flow requirements at (1) Freeport and (2) Rio Vista	Incorporated into CALSIM II
Mokelumne River*	Minimum release rates from Camanche Reservoir	Incorporated into CALSIM II
Stanislaus River	Minimum instream flows below Goodwin Dam	Incorporated into CALSIM II
Tuolumne River	Minimum instream flow requirements at LaGrange Bridge	Incorporated into CALSIM II
San Joaquin River	Minimum instream flow requirements at Vernalis	Incorporated into CALSIM II
Delta	Maximum salinity, minimum dissolved oxygen, minimum outflow, and maximum export	Incorporated into CALSIM II

* Regulatory standards for these rivers are included in pre-processed data. This output is then incorporated into CALSIM II as a single data point.

CVP and SWP Operation

The respective operations of the CVP and SWP are coordinated to manage stream flows in many Central Valley streams and the Delta. Many factors are considered in the operation of the CVP and SWP facilities. Releases from CVP and SWP reservoirs must be sufficient to achieve downstream environmental conditions; such as instream flow, water quality, and water temperature objectives as required at various locations within the river systems and in the Delta.

Operators must meet environmental obligations and also attempt to meet competing demands for Project water. Considerations in determining the required releases include the diversions of CVP and SWP water contractors from the river system, diversions by non-CVP and SWP entities, the contribution of flow into the river system from streams not controlled by the CVP and SWP, the contribution of return flows into the system from agricultural drains and wastewater treatment plants, and operations of other projects.

Sacramento-San Joaquin Delta

Instream flow objectives for the Delta are governed by State and Federal laws and regulations established for the protection of fishery and aquatic resources. Requirements are defined in the following:

- SWRCB Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) (SWRCB 1995);
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) Winter-run Chinook Salmon Biological Opinion (NMFS 1995); and
- U.S. Fish and Wildlife Service (USFWS) Delta Smelt and Sacramento Splittail Biological Opinion (USFWS 1995).

The Bay-Delta Plan establishes measures to protect the beneficial uses of the Bay-Delta and includes objectives that influence the operations of the CVP and SWP. Some of these objectives (specific flow, water temperature, reservoir storage, and diversion requirements) in the Delta were developed through consultation with NOAA Fisheries for the Winter-run Chinook Salmon Biological Opinion. Reclamation operates the CVP in accordance with the terms and conditions in all the various water rights orders, permits, and licenses for the project. Reclamation and DWR both operate their respective facilities in a manner that is consistent with applicable Biological Opinions.

Sacramento River

In addition to the State and Federal laws and regulations governing instream flow objectives in the Delta, the following requirements have been established to protect the fisheries and aquatic resources in the Sacramento River:

- SWRCB water rights terms and conditions for instream flow and flow fluctuation for Keswick Dam and Red Bluff Diversion Dam (SWRCB 1995);
- Central Valley Regional Water Quality Control Board (RWQCB) Basin Plan Water Quality Objectives for temperature and water quality constituents established to maintain fishery uses as approved by the SWRCB under the Federal Clean Water Act (RWQCB 1998);
- Iron Mountain Mine Interim Superfund Site ROD and the Memorandum of Understanding (MOU) with Reclamation concerning dilution manipulation of Spring

Creek Debris Dam releases using Shasta Dam releases (EPA 1997; Reclamation *et al*. 1980);

- NOAA Fisheries Winter-run Chinook Salmon Biological Opinion (NMFS 1995);
- NOAA Fisheries Spring-run Chinook Salmon and Central Valley Steelhead Biological Opinion on interim operations of the CVP and SWP (NMFS 2001); and
- ROD for the Trinity River Restoration Project that contributes to the timing and amount of flow releases at Keswick Dam (USFWS 2000).

Feather River

DWR operates the Oroville Facilities to comply with current Federal Energy Regulatory Commission (FERC) license requirements and other environmental protection measures. These measures include the NOAA Fisheries, NMFS Spring-run Chinook Salmon and Central Valley Steelhead Biological Opinion on interim operations of the CVP and SWP. Instream flows and water quality are managed according to the terms of a 1983 agreement between DWR and the California Department of Fish and Game (CDFG). This agreement establishes criteria for flow and water temperatures in the low-flow channel (Feather River between the Fish Barrier Dam and Thermalito Afterbay outlet) of the Feather River and the reach of the Feather River below the Thermalito Afterbay outlet to the confluence with the Sacramento River. Water temperatures also are regulated under a 1999 agreement between the licensee (DWR) and Joint Water Districts in an effort to assist farmers in achieving agricultural production objectives that rely on warm water. The FERC license requires that DWR attempt to release water that is as close as possible to the maximum allowable under the 1983 DWR-CDFG agreement.

Yuba River

The Yuba River is subject to instream flow requirements according to SWRCB Decision 1644 (D-1644), which came into effect on March 1, 2001. The intent of these requirements is to provide protection for fishery resources and other issues relating to water use and diversion activities in the lower Yuba River (the Yuba River below Englebright Dam). D-1644 specifies new minimum flow requirements (interim and long-term) and flow fluctuation criteria for the lower Yuba River. Because several of the conditions specific to D-1644 are currently being contested and undergoing litigation, they may be subject to revision; SWRCB is soon expected to make a decision soon. Until those proceedings are finalized, the conditions described in D-1644 apply and are incorporated into the hydrologic modeling assumptions.

Additionally, Yuba River operations must comply with the conditions established in the Yuba County Water Agency Act, water rights permits and licenses administered by the SWRCB, FERC License #2246 for the Yuba River Development Project, FERC 1993 License to Pacific Gas and Electric Company (PG&E) for continued operation at the Narrows I Power House, Section 7 of the Flood Control Act of 1944 (at New Bullards Bar Dam and Reservoir), and the 1966 Power Purchase Contract between Yuba County Water Agency (YCWA) and PG&E (Bookman-Edmonston 2000).

Lower American River

Reclamation operates Folsom Reservoir and Dam to comply with the objectives and environmental obligations of the Bay-Delta Plan, NOAA Fisheries Winter-run Chinook Salmon

Biological Opinion, NOAA Fisheries Spring-run Chinook Salmon and Central Valley Steelhead Biological Opinion on interim operations of the CVP and SWP, USFWS Delta Smelt Biological Opinion; USFWS Splittail Biological Opinion, and the management of CVPIA (b)(2) water. Reclamation also operates Folsom Dam according to year round flow requirements established by SWRCB Decision 893 (D-893). When possible, CVP operations also try to meet the Anadromous Fisheries Restoration Program (AFRP) flow objective for the lower American River as set forth in the November 20, 1997 Department of the Interior Final Administrative Proposal on the Management of Section 3406(b)(2) Water.

CVP and SWP Allocation
Reclamation operates the CVP to balance many competing objectives including water quality, fish and wildlife protection, irrigation and domestic water supply, hydroelectric power production, and flood control. In some years, the demand for water exceeds available supplies or exceeds export or conveyance capacities and Reclamation must adjust its allocation of water among the uses. Authorizing legislation, statutes, regulations, and agreements guide Reclamation's decisions in determining water allocations. In a similar manner, DWR balances the SWP's many competing objectives.

One of the critical operating decisions for the CVP and SWP is the annual water supply allocation. When specific water supply indices indicate an insufficient amount of water supply to meet all demands, allocation deficiencies are imposed depending upon the contract type. The Settlement and Exchange Contractors and the CVP wildlife refuges receive either 100 percent (normal and wet years) or 75 percent (critical years) allocation based on the Shasta Index.

The remaining and majority of CVP contracts receive allocations on a sliding scale based on a comparison of forecast demand and supply for the March through September period. As the simulation is run, CALSIM II compares water demand and available water supply for the March through September period. If the supply is greater than the demand, a full allocation is made. If the supply is less than the demand, allocations are reduced incrementally in response to the severity of the simulated shortfall. CVP M&I contracts receive allocations ranging from 50 to 100 percent. CVP agricultural contracts receive allocations ranging from 0 to 100 percent. Agricultural allocations are reduced first and reductions to the M&I allocations start after the agricultural allocations have been reduced to 75 percent of the full contract allocation. SWP allocations impose deficiencies equally to agricultural and M&I water users.

2.2.1.2 Upstream from the Delta Region – Proposed Action Simulation
This section describes the assumptions applied to the CALSIM II modeling and pre- and post-processing applications to simulate implementation of the EWA water purchases and fish actions proposed to occur under the Proposed Action.

The Proposed Action simulation represents the conditions that would occur with implementation of the EWA Flexible Purchase Alternative. It is assumed that the EWA Program would be implemented between 2004 and 2007. Preliminary EWA activities occurred in water years 2000, 2001 and 2002, under a series of agreements executed by the Project Agencies to provide the required water for the EWA. (See EIS/EIR Executive Summary and http://wwwoco.water.ca.gov/calfedops/2001ops.html or http://wwwoco.water.ca.gov/calfedops/2002ops.html.)

Development of the Proposed Action simulation utilizes the CALSIM II benchmark study used in the Baseline Condition (refer to Section 2.2.1.1). The Proposed Action simulation, therefore, involves the same period of record and hydrology LOD. Because the timeframe for the EWA Program is relatively short (lasting only until 2007), relative to future condition demands (represented by 2020) that are used by CALSIM II, there is little variation between 2001 demands and projected 2007 demands. As a result, the hydrology used in the CALSIM II benchmark study (LOD 2001) was determined appropriate for use in the evaluation of "future" (2007) EWA conditions.

The modeling assumptions incorporated into the CALSIM II benchmark study and utilized in further development of the Flexible Purchase Alternative results are summarized in Table 2. The sections following Table 2 provide additional detailed explanation of these parameters and assumptions.

The Proposed Action would allow the EWA agencies to purchase up to 600 TAF of water and would not restrict acquisition quantities upstream from the Delta or within the Export Service Area. The EWA agencies could freely combine acquisition methods, water sources, and operational flexibilities to effectively respond to annual changes in hydrology and fish behavior in the Delta.

Although the flexibility in water acquisitions incorporated into the Proposed Action enables and enhances the success of the program, determining the appropriate manner in which to represent the various elements of the Proposed Action in the modeling effort becomes complicated. Because the program is designed to be highly responsive to different conditions that may occur in any given year, there are a number of unknowns associated with its implementation.

The following sections describe the assumptions and tools used to simulate the Proposed Action. These methods were developed with input from and through coordination with the project agencies (DWR and Reclamation) and the management agencies (NOAA Fisheries, USFWS, and CDFG), and were determined to be the best approach considering available information or data sets and current modeling tools and applications.

Proposed Action Operations

The EWA Program allows for operational changes of the CVP and SWP facilities that benefit fish. Fish actions that could be implemented to protect and enhance fish species recovery include 1) reductions in Delta export pumping at the CVP and SWP pumping plants; 2) closure of the Delta Cross Channel Gates; 3) increases in instream flow; and 4) increases in Delta outflow. Additionally, EWA assets acquired by the Project Agencies will be used to repay CVP and SWP contractors for water used for fish actions that would have otherwise been delivered to the Export Service Area.

The Project Agencies determine the quantity of water that can be made available each year to agricultural and urban contractors within the Export Service Area. The agencies then move that amount of water, either from natural flows within the Sacramento River and San Joaquin River Basins or from Project reservoirs upstream from the Delta, through the Delta using the export pumping plants.

For the purposes of modeling and associated effect assessment of the Proposed Action purchases on CVP and SWP operations, instream flows, and instream water temperatures of conveying the water from the area of water purchase to the Delta assumes 1) EWA would purchase 600 TAF[1] of water from the Upstream from the Delta Region in every year, limited only by the availability of CVP and SWP export capacity to pump the purchased water; and 2) the EWA would have up to 600 TAF of water available to implement EWA fishery protection and recovery actions in the Delta. The assumed acquisitions up to 600 TAF of EWA assets would be used solely to repay the CVP and SWP for water foregone due to export pumping reductions generally implemented during the December through July period.

The effect analyses for flow-related issues for fisheries does not depend on the location of a particular seller but on the total amount of EWA water to be transferred via a particular tributary and receiving water body. Therefore, these resources were evaluated based on the largest amount of water that EWA agencies could manage for Delta fish actions (600 TAF), from the Upstream from the Delta Region, regardless of whether the specific water sellers could be identified at this time.

Water Purchases

The Proposed Action covers a range of EWA water purchases extending from a minimum of 75 TAF to a maximum of 600 TAF in the Upstream from the Delta Region. The actual water purchases in any given year to support the EWA would vary based on fisheries needs, budgetary constraints and other factors. The total amount of water available for purchase by the EWA Program as assets generally would be dependent upon water year type. Assumptions (transfer allocations) specific to each river, basin or seller were developed for the long-term hydrologic record, which represents a variety of water year types. Two scenarios were developed to aid in the evaluation of the Proposed Action water purchase and the potential effects upon environmental resources affected by: 1) transfer of water assets from areas within the Upstream from the Delta Region and the Export Service Area to the Delta; and 2) modifications to pumping practices at the CVP and SWP pumping plants. Constraints on the scenarios include:

- The maximum volume of water that would be obtainable from all upstream contributing sources to support a 600 TAF export at the Delta.
- The minimum water volume available from any individual upstream contributing source is zero acre-feet.

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1 Although the Proposed Action calls for the purchase from the Upstream from the Delta Region of up to 600 TAF and that carriage water cost would be deducted from that quantity, for this scenario it was assumed that sufficient water would be purchased to allow the export of 600 TAF at the CVP and SWP pumping plants. See discussion of carriage water at Section 2.1.2.5. This is more water than the EWA would purchase under this alternative resulting in an effect analysis of potentially greater effects than would occur under the Proposed Action. This was done so this analysis could also serve as the cumulative effect analysis. The cumulative case would be that the EWA and other water purchase programs would purchase the full 600 TAF when sufficient export capacity was available. In that case the other water purchasers would purchase sufficient water to allow the full 600 TAF to be exported at Banks and Tracy and, therefore, would purchase sufficient water to cover carriage water cost. This will require very few years during which more than the 650 TAF shown available in Table 10 will be purchased. To cover this shortage, annual crop idling was assumed to be as great as 250 TAF in both the Feather and Sacramento River regions to account for potential, presently unidentified, water purchase assets. These assumptions result in an evaluation of the worst possible case for environmental effect analysis.

The Proposed Action would utilize various combinations of the elements described in Chapter 2 of the ASIP as a means of achieving the desired water allocation. As shown in Table 10, each river system or potential selling entity may have a certain amount of water available to EWA; however, it may come from one individual source within the system or a combination of sources. As such, there could be no water available for purchase from any individual river or source for any given year. This analysis must consider the possibility of these situations because in any given year, a particular river, basin, or seller may provide no contribution to EWA. For the purpose of a comprehensive analysis, the minimum amount of purchased water that would be considered under the Proposed Action is zero acre-feet. However, to comply with CALFED ROD prescriptions for the minimum annual acquired surface water assets from the Upstream from the Delta Region, it is expected that a total quantity of 35 TAF will be exported, regardless of water year type. This volume of water is a relatively small amount that does not exceed the EWA's dedicated conveyance capacity in the Delta, even during wet years. The total may come from any individual river, basin, seller, or a combination of multiple sources.

Because of the uncertainty in where and what amounts water will be purchased for the EWA, it was determined that information and analyses provided in the EIS/EIR should encompass all reasonable actions. Two factors that affect the estimated EWA water purchases include 1) presently identified estimates of potential water assets (Table 10); and 2) the desire to purchase 600 TAF of water assets from the Upstream of the Delta region for the Proposed Action.

Table 10
Potential Range of EWA Asset Acquisitions for the Flexible Purchase Alternative

CALFED Region	Range of Possible Acquisitions (TAF)				Management Actions (TAF)		Transfers (TAF)	
	Stored Reservoir Water	Groundwater Substitution	Crop Idling	Stored Groundwater Purchase	Source Shifting	Groundwater Storage Services	Maximum Transfer Volume	Probable Transfer Period
Upstream North of Delta								
Sacramento River Region								
GCID		20-60	100				135	Jun-Sep
Reclamation District 108		5	45				20	Jun-Sep
Anderson Cottonwood ID		10-40					40	Jun-Sep
Natomas Central MWC		15					15	Jun-Sep
Other Sacramento River Contractors								
Feather River Region								
Oroville Wyandotte ID	10-15						15	Nov-Dec
Western Canal WD		10-35	70				50	Apr-Sep
Joint Water District Board		20-60	65				110	Apr-Sep
Garden Highway MWC		15					15	Jun-Sep
Other Feather River Contractors								
Yuba River Region								
Yuba County Water Agency	100						100	Jul-Sep
Yuba County Water Agency		85					85	May-Feb
American River Region								
Placer County Water Agency	20		10				30	Jul-Sep
Sacramento Groundwater Authority				10			10	Jul-Sep
Merced/San Joaquin Region								
Merced Irrigation District		10-25					25	Oct-Dec
Export Service Areas								
Tulare Lake Sub-Basin								
Kern County Water Agency			115	50-165	X	X	250	Jan-Dec
Semi-Tropic Water Storage District[1]						X	X	Jan-Dec
Arvin-Edison Water Storage District[1]						X	X	Jan-Dec
Westlands Water District			195				195	Apr-Sep
Tulare Lake Basin WSD			110				110	Apr-Sep
Southern California Region								
Metropolitan WD of Southern California					100-200		200	Jan-Dec

[1] Semi-Tropic WSD and Arvin-Edison WSD are within Kern County Water Agency. Their groundwater storage facilities are separate from the Agency, but they may participate in other programs that the agency helps administer, such as crop idling.
X = unknown quantity

To compensate in part for the perpetual availability of maximum individual asset quantities, modeling performed for the Flexible Purchase Alternative, in some cases, used EWA asset quantities less than the maximum identified for a particular river, basin or seller. The result from this procedure identifies maximum EWA instream flow effects, but could misidentify maximum reservoir, landside, and economic effects. To ensure that the EWA EIS/EIR presents a thorough picture of reasonable effects in these non-instream flow areas, some analyses in the EIS/EIR take the additional step of looking at maximum utilization of identified assets. This two-level procedure guarantees that all of the effects of the EWA (instream, landside, and economic) are addressed. Identifying the location, amount, and type of potential individual water purchases in the Upstream from the Delta Region is critical to determining the instream flow, water temperature, reservoir storage change, and potential water quality effects of the EWA Program. There are numerous possible combinations of water purchases in the Upstream from the Delta Region. Multiple studies to analyze all of the combinations were not feasible because of the time and cost of such an effort. It was decided to design one set of assumptions that could be adjusted to account for all other potential water purchase combinations and allow for qualitative assessments of the potential environmental effects.

The EWA agencies prioritized the types and amounts of water purchases in the Upstream from the Delta Region, as follows (water purchase decision priority):

- Water would be purchased first from the Upstream from the Delta Region, limited by the available SWP and CVP export capacity, and second from sellers in the Export Service Area.
- Purchases from reservoir storage would be used before any other purchase option is pursued.
- Stored groundwater purchases would be pursued as a second option after all reservoir storage purchases have been utilized.
- Groundwater substitution purchases would occur if more water were needed than can be obtained from reservoir storage and stored groundwater purchases.
- Water purchases obtained by idling rice would be pursued as a final option if more water were required to satisfy EWA requirements.
- Idling rice in the Feather River Basin would be pursued before idling rice in the Sacramento River Basin because some water from Sacramento River purchases could not be stored in Lake Shasta during April, May, and June when instream water temperature obligations require the water to be released.

These assumptions and priorities were utilized in the post-processing applications to develop model output results for the Flexible Purchase Alternative.

Fish Actions

The behavior of fish at the Delta pumps, such as the timing of their arrival (typically late winter /early spring) and the length of their stay, varies from year to year and cannot be predicted in advance. Years in which the fish arrive late and leave early may have fewer pumping reductions than other years and would have adequate assets to cover those reductions as well as providing water for upstream fish enhancements (increased instream flows).

EWA actions would be implemented primarily in the winter and spring months, which are months that the SWP and/or CVP would be required to reduce export pumping to protect and assist in restoration of listed and candidate fish species. The water supply lost due to pumping reductions during these months would be repaid in whole or in part during the summer by water acquired upstream from the Delta Region and pumped through the Delta to the downstream CVP/SWP water users. It is assumed that the water acquired reaches the Delta during July through September and is pumped at the Projects' pumping plants during that same period.

The CALSIM II benchmark study does not include the CALFED EWA actions, therefore, the post-processing tools, EWA Water Purchases.xls and EWA Routing.xls (Sections 2.1.3 and 2.1.4, respectively), were utilized to integrate the appropriate EWA actions into the modeling process to develop the Flexible Purchase Alternative simulation results used in the Upstream from the Delta Region effect analysis.

The EWA Water Purchases.xls post processing tool incorporates the assumed EWA Actions (export reductions) to simulate the CVP/SWP reservoirs changes and changes in their associated rivers in the Upstream from the Delta Region. The EWA water purchases used to represent the Flexible Purchase Alternative for this region are described in detail in Sections 2.2.1.2 and 2.2.2.2.

Delta Export Capacity

EWA asset management activities also involve use of the Delta pumps when capacity is available. Generally, drier water year types provide greater opportunities for conveyance of EWA water. In wet years, most of the Delta export conveyance is utilized by the SWP and CVP. During wet years, the Delta pumps export water at nearly 100 percent of their capacity during the summer transfer window, leaving minimal export capacity available for moving EWA assets. In drier years, the Delta export pumps are not running at capacity, leaving more capacity available to move EWA assets during the summer transfer window. During dry years, the EWA agencies would have fewer requirements to replace water lost during pumping reductions because the pumps would not have been operating at full capacity without the EWA. Therefore, the EWA project agencies may need to make fewer water acquisitions during dry years.

These EWA transfers require the utilization and implementation of various upstream combinations of groundwater substitution, stored reservoir water, and crop idling activities in order to achieve the maximum annual EWA purchase allowance (600 TAF) of effective water. Effective water is the total volume of water that is made available for export at the Delta pumping stations. To compensate for losses incurred through conveyance and the seasonality of crop idling activities, initial asset purchases may exceed 600 TAF. It is estimated that purchase losses may range between 20 to 50 percent of the initial acquisition. Table 10 considers these conditions by listing the range of the total purchases required to provide the maximum quantity (600 TAF) of water from EWA's suite of sources available for export at the Delta. In the Export

Service Area, source shifting and borrowed project water also may be employed, in addition to groundwater substitution, stored reservoir water and crop idling activities.

The amount of water that would be purchased in the Upstream from the Delta Region was limited to that amount which could be exported by the SWP and CVP pumping plants after all project pumping requirements were fulfilled.

The EWA Water Purchases.xls and EWA Routing.xls post-processing tools were used to determine the amount of available Delta export capacity at the CVP and SWP pumping plants that was in excess of Project requirements and that could be used to transfer EWA assets purchased from the Upstream from the Delta Region. As discussed in Section 2.1.3.2, two limiting factors were considered in the assessment of the CALSIM II results: 1) unused export capacity (physical capacity); and 2) E/I ratio (using inflow to Delta and Delta export variables). Using pooled seasonal export capacities (July through September total), limited when necessary by the E/I ratio, from all years in the modeled period of record, the potential annual EWA export amounts ranges between 75 TAF and 600 TAF.

For modeling purposes, it was assumed that the EWA Program would have the ability to utilize the full available capacity. However, it is recognized that there are other programs with authority to utilize Delta export capacity when it is available, and that the full amount likely would not be available to the EWA Program. Therefore, this assumption provides a conservative or worst-case representation of the effect associated with using this capacity, but the effects would not be due solely to the EWA Program (see discussion of Cumulative Considerations below).

It is recognized that in real-time, there are a number of factors that would limit the ability of the EWA Program to utilize the full amount of export capacity including competing transfers, hydrology (including the timing of precipitation and runoff), facility outages, operational constraints, and other environmental factors and variables. Additionally, the CALFED ROD and the EWA 2003 Interim EWA Protocols establish priorities for determining and assigning the use of any excess capacity available at the CVP and SWP pumping plants. Those priorities are described below.

SWP pumping (from highest to lowest):

- First priority - SWP Pumping[2]
- Second priority - Water Transfers for SWP contractors
- Third priority - Joint Point of Diversion (JPOD) use for specific CVP Contractors (example: Cross Valley Canal)
- Fourth priority - Wheeling for CVP and EWA
- Fifth priority - Water transfers for others

[2] The water that will be produced by the Sacramento Valley Water Management Agreement will be used to meet D-1641 water flow requirements, which are now being met, by the CVP and SWP. This will result in the SWP dedicating less water to meeting D-1641 flow requirement and this “saved” water would be pumped as by the SWP to SWP contractors south of the Delta. Therefore, the analysis assumes that any water produced by the Sacramento Valley Water Management Agreement for the SWP would be considered as included in SWP pumping.

CVP pumping (from highest to lowest):

- First priority - CVP Pumping[3]
- Second priority - Refuge Level IV
- Third priority - Cross Valley Canal
- Fourth priority - EWA water
- Fifth priority - Water transfers for others

Although estimates of the excess capacity that might remain for EWA purposes after other priority programs utilize what they need could be made, those estimates would not be absolutely correct in all years. If the estimates are high in any year, the potential effects of conveying EWA water from the areas where the water is purchased to, and through the Delta, could be underestimated. For this and other reasons it was assumed that all of the capacity available would be used by EWA and the resultant environmental effects analyzed for conveying the water purchased in the Upstream from the Delta Region and exporting that water. Therefore, any quantity of water purchased and utilized by the EWA and the environmental effects associated with such action would be analyzed in the EIS/EIR.

Cumulative Considerations

The Flexible Purchase Alternative, as described for modeling and effect assessment purposes, represents a cumulative condition. Although it is recognized that the EWA program may not actually purchase and transfer 600 TAF in each year of the program, there are other water acquisition and transfer programs that would purchase water and utilize excess capacity at the Delta pumping facilities. Therefore, the evaluation of purchasing and transferring 600 TAF from the Upstream from the Delta Region to the Delta and the summer exports from the Delta to the Export Service Area represents a cumulative condition in addition to a year of maximum EWA purchases from the Upstream of the Delta Region.

The other programs considered as reasonably foreseeable future actions include: implementation of the Sacramento Valley Water Settlement Agreement, other water purchases by the SWP and CVP on behalf of the Projects' water contractors, and water purchases by SWP contractors.

The Sacramento Valley Water Management Agreement ultimately will require export of up to 185 TAF in critical, dry, below normal, and in some above normal water years. However, this agreement involves staged implementation, increasing the agreed upon water exports incrementally over time, and it is anticipated that the full 185 TAF would be required sometime after 2007 (which represents the end of the EWA study period for the EWA EIS/EIR).

Because the SWP is not capable of meeting the SWP contractors' water supply requirements in many years, the contractors purchase water from areas upstream of the Delta in critically dry, dry, and some below normal water years. The CVP will utilize its share of unused SWP pumping plant export pumping capacity to export CVP stored water to CVP water contractors, the CVP's share of the Sacramento Valley Water Management Agreement water, and water purchased by CVP water contractors.

[3] The Sacramento Valley Water Management Agreement affects the CVP in the same way the agreement affects the SWP as explained in footnote #2. Therefore, the analysis assumes that the water produced by the Sacramento Valley Water Management Agreement for the CVP would be considered as included in CVP pumping.

Application of Analysis

The analysis of the Flexible Purchase Alternative is based on the maximum amount of purchases (600 TAF) that might occur Upstream from the Delta on a very infrequent basis (less than 15 percent of the time). As such, this analysis depicts the maximum EWA fishery benefits achievable as well as the maximum offsetting of those benefits due to summer pumping of the EWA water. The accompanying analysis of potential environmental effects provides the EWA Project Agencies the maximum decision-making flexibility for utilizing EWA assets of any amount up to 600 TAF of water, and the maximum flexibility for pumping water purchased from the Upstream from the Delta Region to O'Neill Forebay. It also provides for flexibility in making decisions regarding EWA fish actions, not only for reducing CVP and SWP export pumping from the Delta to improve aquatic habitat, but also to perform other identified EWA fish actions such as: closing the Delta Cross-Channel gates, increasing instream flows, increasing Delta outflow, or any other aquatic habitat improvements to benefit targeted fish resources.

The analysis of the Flexible Purchase Alternative assumes all unused Delta export capacity is used by EWA. The analysis provides an evaluation of maximum effects within the Delta because the maximum level of pumping would occur during summer months. This pumping offsets the benefits to fish achieved at other times of year due to the pumping reductions implemented under the fish actions, thereby lowering the overall benefits to fish that would be achieved with pump reductions alone. However, not all of the unused Delta export capacity would be available to the EWA Program, so overall, the fishery benefits associated with the Proposed Action likely are underestimated.

By providing an assessment of regulatory compliance with the maximum water purchase amount, the agencies are afforded greater latitude in making operational decisions to implement fish actions while also keeping the Project contractors whole. The alternative also provides greater opportunities for Delta outflow benefits and for upstream flow enhancements.

The analysis represents a worst-case simulation of effects that may occur in the Upstream from the Delta Region. Therefore, purchase and transfer of less than the maximum amount generally would be expected to result in reduced environmental effects.

This analysis also may prove useful to other agencies considering water transfer programs by providing an indication of potential effects related to individual project and cumulative conditions.

<u>Effect Assessment Comparison – Upstream from the Delta Region</u>

The Proposed Action simulation was compared to the basis of comparison simulation to identify the potential changes in the CVP/SWP hydrologic conditions (e.g., instream flow, reservoir elevations, end-of-month storage, and water temperature) that could influence aquatic resources. The evaluation of environmental effects was performed by considering the modeling results from the comparison in light of the effect indicators and evaluation criteria developed for the flow-related resource areas. The effect indicators and evaluation criteria are provided in the individual resource chapters of the Draft EIS/EIR and in Chapter 4 of the ASIP, and identify the parameters evaluated, including specific locations and seasonal considerations within the area of analysis specific to the resource being evaluated.

Due to the relatively short-term nature of the EWA Program, the Proposed Action includes all reasonably foreseeable future projects or actions that would typically be incorporated into a cumulative condition simulation, therefore, a separate modeling simulation for the cumulative condition was not performed. As described in the EIS/EIR (Chapter 3), the modeling for a cumulative effect assessment comparison would be the same as the assessment comparing the Proposed Action to the basis of comparison. Similarly, the basis of comparison represents existing conditions as well as future No Action/No Project conditions. Therefore, a separate modeling simulation was not developed for the No Action/No Project Alternative.

2.2.2 Delta Region Analysis

Separate modeling simulations and assumptions were developed for the evaluation of flow-related resource effects for the Delta Region analysis. The following sections describe the approach utilized to assess fisheries in the Delta.

2.2.2.1 Delta Region – Basis of Comparison Simulation

The basis of comparison for the Delta Region analysis was developed using the same modeling tools and pre- and post-processing applications as described for the Upstream from the Delta Region (Section 2.2.1), with the exception of the hydrologic period of record. The hydrologic period of record for the Delta Region analysis extends over a 15-year period, from 1979 through 1993. Although not as extensive as the 72-year period utilized for the Upstream from the Delta Region simulations, the 15-year period of record encompasses a variety of water year types and is considered representative of conditions that may occur over the EWA Program period (2004 to 2007).

The 15-year period of record for the Delta Region analyses corresponds with the data available to conduct the Delta fish salvage modeling. (Refer to Section 3.0.) It was determined appropriate that the evaluation of flow-related issues within the Delta Region analyses be consistent for all effect indicators utilized for aquatic resources.

2.2.2.2 Delta Region – Proposed Action Simulation

The Proposed Action simulation for the Delta Region analysis was developed using the same modeling tools and pre- and post-processing applications as described for the Upstream from the Delta Region with some modifications. As for the Delta Region basis of comparison described above, the Proposed Action simulation used in the Delta Region analyses is based upon a 15-year period of record.

The Proposed Action incorporates a high amount of flexibility into the purchases; however, exact amounts of water to be purchased every year remain unknown. To account for variability from one year to the next, the modeling effort evaluated two scenarios. The first scenario, the Maximum Water Purchase Scenario, examined a worst case for environmental effects and a best case for fish benefits: the EWA project agencies purchased the maximum amount possible from the Upstream from the Delta Region. The second scenario, the Typical Water Purchase Scenario, examined a more typical year of operations to quantify adverse and beneficial effects. This scenario, however, like the Maximum Water Purchase Scenario, assumes that all unused Delta export pumping capacity for the summer months (July through September) would be available to the EWA Program. While this assumption permits evaluation of the potential worst-case for EWA export pumping, there are other water acquisition and transfer programs and SWP/CVP programs that have priority access to use this available pumping capacity.

Therefore, this scenario does not necessarily represent the conditions that would be expected to occur for any given year of the program.

In effect, these two scenarios "bracket" the evaluation of aquatic resource effects related to changes in Delta pumping associated with implementation of the EWA Program. Assumptions specific to each scenario are described in the following sections.

Maximum Water Purchase Scenario

Operation of the Proposed Action under this scenario assumes 1) EWA would purchase 600 TAF of water from the Upstream from the Delta Region in every year, limited only by the availability of CVP and SWP export capacity to pump the purchased water; and 2) the EWA would have up to 600 TAF of water available to implement EWA fishery protection and recovery actions in the Delta. The assumed acquisitions of up to 600 TAF of EWA assets are used solely to repay the CVP and SWP for water not pumped during export pumping reductions (associated with EWA fish actions generally implemented during the December through July period).

Based on these assumptions, the results of this analysis describe the maximum adverse environmental effects within water bodies (reservoirs and river systems) in the Upstream from the Delta Region because it assumes purchases from this region are based upon the maximum amount of water that that can be pumped from the Delta. This analysis also provides an analysis of the maximum potential fishery benefits that could be provided by the EWA Program under the Proposed Action because the maximum amount of water that could be transferred to the Delta would be purchased each year.

The modeling results for the Proposed Action assumes all unused Delta export capacity is used by EWA. The analysis provides an evaluation of maximum effects within the Delta because the maximum level of pumping would occur during summer months. This pumping offsets the fishery benefits achieved at other times of year due to the pumping reductions implemented under the fish actions, thereby lowering the overall fishery benefit that would be achieved with pump reductions alone. However, not all of the unused Delta export capacity would be available to the EWA Program, so overall, the fishery benefits associated with the Proposed Action likely are underestimated.

The purchase of EWA assets is modeled assuming that the program would first obtain EWA variable assets such as relaxation of the allowable E/I ratio in the D-1641 water rights decision as allowed by that decision for fishery aquatic habitat improvement, then, additional purchases would be made from the Upstream from the Delta Region (to the extent that Delta export capacity is available).

Maximum Purchase Scenario - Specific EWA Fish Actions

The development of modeling assumptions for this scenario included the identification of potential specific EWA actions that would likely be imposed for the conditions represented by the historical hydrologic period of record, assuming current level of demand and regulatory conditions.

Because of the complexities inherent in developing a specific list of actions applied to historical conditions, it is possible that the EWA actions selected and used in the modeling of this scenario do not exactly reflect what the management and project agencies may decide each year. Still, the advantages of providing a quantitative evaluation of potential conditions outweighs the uncertainties associated with this method. A substantial amount of information and data are available and were utilized in the determination and assignment of specific actions for each of the study years (1979 to 1993). These sources include:

- CALFED agencies' staff and stakeholder representatives studied how the CVP and SWP would be operated to determine how EWA would have been implemented for the period 1981 to 1994. They used operations model output, fish salvage data, water temperature and turbidity data. This work was relied on heavily for the EWA EIS/EIR Delta Region analysis; in particular, to estimate the EWA asset requirements to allow the EWA management agencies to ensure provision of ESA commitments of the CVP and SWP. Additionally, review of these studies provides insight into the decision-making strategies developed by the agencies to determine the likely EWA actions that would occur and the priorities used by the management and project agencies to determine EWA assets when the total amount is insufficient to implement all EWA actions the if unlimited assets were available.

- The EWA management agencies implemented EWA actions over the past three years. (2001 through 2003), Actions were generally one-year water transfers with willing sellers approved under CEQA initial studies/negative declarations and NEPA environmental assessments/findings of no significant impact. Experience gained in making these purchase, water transfers and in implementing EWA fish actions provides valuable real-time information regarding the types of actions the agencies select with limited data during the year as well as some indication of how the fish may behave under various hydrologic and operational conditions.

- The historical fish salvage at the Tracy Pumping Plant and Banks Pumping Plant.

- Delta flow conditions available from CALSIM II.

- Delta water quality conditions available from DSM2 (using input data from the CALSIM II model).

The EWA actions and the purpose for selecting each action assumed in the Maximum Water Purchase Scenario are shown in Table 11. Export pumping of purchased water begins on July 1 unless an EWA action occurs in July or it is otherwise delayed if fish species of concern are observed in the Delta. Under such conditions, export pumping of purchased water would not start until the EWA action is completed.

Table 11
EWA Actions Simulated for the Maximum Water Purchase Scenario

Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
1979	Below Normal	Dec – Reduce export pumping by 30 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce spring and possibly winter-run Chinook salmon salvage. Also reduces adult delta smelt salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs.	Reduce delta smelt salvage going into VAMP. Also reduces steelhead, splittail, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 5,000 cfs.	Reduce delta smelt, steelhead, splittail, and salmon salvage.
		Jun - Reduce exports by 60 TAF	Reduce delta smelt and heavy splittail salvage.
1980	Above Normal	Dec – Reduce export pumping by 60 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Jan - Reduce export pumping by 30 TAF	Reduce spring-run Chinook salmon and splittail salvage.
		Feb - Reduce export pumping by 30 TAF	Reduce winter-run Chinook salmon, and adult delta smelt salvage.
		Mar -Reduce export pumping by 20 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 3,000 cfs.	Reduce delta smelt salvage going into VAMP. Also reduces splittail, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs total pumping.	Implement VAMP study.
		Jun - Reduce Banks P.P. export pumping to 2,000 cfs.	Reduce delta smelt and heavy splittail salvage.
		Jul 1st – Jul 15th - Reduce export pumping by 1,500 cfs	Reduce salvage of delta smelt
1981	Dry	Dec – Reduce export pumping by 20 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon, splittail, steelhead, and adult delta smelt salvage.
		Mar -Reduce export pumping by 200 TAF	Reduce winter-run Chinook salmon, steelhead, and adult delta smelt salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs	Reduce delta smelt, steelhead, splittail, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		May 16th – 31st – Reduce export pumping to 2,500 cfs	Reduce delta smelt and heavy splittail salvage.
		Jun - Reduce export pumping by 30 TAF,	Reduce delta smelt and heavy splittail salvage
		Jul - Reduce export pumping by 90 TAF	Reduce delta smelt salvage

Table 11
EWA Actions Simulated for the Maximum Water Purchase Scenario

Water Year	Year Type	EWA Actions	Reason for Action
1982	Wet	Dec – Reduce export pumping by 40 TAF	Export reductions may be required in Dec to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 40 TAF	Reduce spring-run salmon salvage
		Feb - Reduce export pumping by 60 TAF	Reduce winter-run salmon, splittail, steelhead, and adult delta smelt.
		Mar -Reduce export pumping by 60 TAF	Reduce salvage of winter/spring-run salmon, steelhead and adult delta smelt salvage.
		Apr –Reduce export pumping by 120 TAF	Reduce heavy salvage of steelhead and salmon salvage.
		May - Reduce export pumping by 120 TAF.	Reduce splittail, steelhead and salmon salvage.
		Jun - Reduce export pumping by 90 TAF,	Reduce delta smelt and splittail salvage
1983	Wet	Dec – Reduce export pumping by 150 TAF	Reduce heavy spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 120 TAF	Reduce spring-run salmon and adult delta smelt salvage
		Feb - Reduce export pumping by 120 TAF	Reduce spring/winter-run salmon and adult delta smelt salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter/spring-run salmon, steelhead, and adult delta smelt salvage.
		Apr –Reduce export pumping by 60 TAF.	Reduce salmon salvage and heavy splittail salvage.
		May - Reduce export pumping by 60 TAF.	Reduce heavy splittail and salvage of steelhead salvage.
		Jun - Reduce export pumping by 120 TAF,	Reduce delta smelt and splittail salvage.
1984	Wet	Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs.	Reduce splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 4,000 cfs.	Reduce delta smelt and splittail salvage.
		Jun 1st – Jun 15th - Reduce export pumping by 60 TAF.	Reduce delta smelt and splittail salvage.
1985	Dry	Dec – Reduce export pumping by 60 TAF.	Reduce spring run Chinook salmon salvage.
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, steelhead and splittail salvage
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs	Reduce splittail and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		Jun 1st – Jun 20th - Reduce export pumping by 150 TAF.	Reduce heavy delta smelt and splittail salvage.

Table 11
EWA Actions Simulated for the Maximum Water Purchase Scenario

Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
1986	Wet	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Jan - Reduce export pumping by 30 TAF.	Reduce spring-run Chinook salmon salvage.
		Feb - Reduce export pumping by 90 TAF	Reduce spring-run salmon and adult delta smelt salvage.
		Mar -Reduce export pumping by 150 TAF	Reduce splittail, steelhead, and winter-run salmon salvage.
		Apr - Reduce export pumping by 90 TAF.	Reduce salmon, delta smelt and splittail salvage.
		May - Reduce export pumping by 90 TAF.	Reduce delta smelt salvage and the heavy salvage of splittail.
		Jun - Reduce export pumping by 120 TAF.	Reduce delta smelt salvage and the heavy salvage of splittail.
1987	Dry	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF.	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon salvage
		Mar -Reduce export pumping by 200 TAF	Reduce salvage of winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 3,000 cfs	Reduce steelhead, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		Jun 1st – Jun 20th - Reduce export pumping by 70 TAF.	Reduce delta smelt and splittail salvage.
		Jul – Reduce export pumping by 30 TAF the first week of July.	Reduce delta smelt salvage
1988	Critical	Dec – Reduce export pumping by 120 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 90 TAF.	Reduce spring-run Chinook salmon salvage.
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon salvage.
		Apr 1st –Apr 14th – reduce export pumping to 3,500 cfs.	Reduce salmon, delta smelt, and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,500 cfs.	Reduce delta smelt and splittail salvage
1989	Dry	Jan - Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 30 TAF	Reduce spring-run Chinook salmon and adult delta smelt salvage.

Table 11
EWA Actions Simulated for the Maximum Water Purchase Scenario

Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
		Mar -Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export pumping.	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 4,500 cfs.	Reduce delta smelt and splittail salvage
		Jun – Reduce export pumping by 30 TAF.	Reduce delta smelt and splittail salvage
		Jul - Reduce export pumping by 90 TAF	Reduce delta smelt and splittail salvage
1990	Critical	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 90 TAF.	Same as above.
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon salvage
		Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, split, and adult delta smelt salvage
		Jun – Reduce export pumping to 1,500 cfs	Reduce delta smelt salvage.
1991	Critical	Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 1,500 cfs.	Reduce salmon, adult delta smelt, and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,500 cfs.	Reduce delta smelt and splittail salvage
1992	Critical	Jan - Reduce export pumping by 30 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 2,500 cfs.	Reduce salmon salvage
		Apr 15th – 30th – reduce export pumping to 1,500 cfs	Reduce salmon salvage
1993	Above Normal	Jan - Reduce export pumping by 30 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon, splittail, and steelhead salvage
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Mar -Reduce export pumping by 90 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 10,000 cfs.	Reduce salmon and steelhead salvage.
		Apr 15th – May15th - VAMP @ 1,500 cfs export.	Implement VAMP
		Jun 1st – 15th - Reduce export pumping to 6,000 cfs	Reduce delta smelt and splittail salvage

The Maximum Water Purchase Scenario assumes that up to 600 TAF of EWA assets are available each year and that those 600 TAF would be purchased from the Upstream from the Delta Region limited only by available Delta export pumping capacity at the CVP and SWP pumping plants. The EWA actions assumed to occur under the Maximum Water Purchase Scenario (Table 11) do not require 600 TAF of EWA assets in every year. In those years, the modeling assumes that only the amount of EWA assets required are purchased from the Upstream from the Delta Region or the amount of available export pumping capacity at the CVP and SWP pumping plants, whichever is less.

Calculations were performed to determine the amount of export reductions associated with the EWA actions assumed under the Maximum Water Purchase Scenario (Table 12), the EWA assets required to implement the EWA actions, and the amount of purchased water pumped at the Banks and Tracy pumping plants to CVP and SWP contractors during the July through September period for each of the 15 years studied in this analysis.

Table 12
Maximum Water Purchase Scenario - EWA Export Reductions, EWA Assets Required, and Water Purchase Pumping (TAF)

Analysis Year	*EWA Export Reductions*	*EWA Assets Required*	*Pumping of EWA Water at Banks and/or Tracy Pumping Plants*
1979	604	484[a]	213
1980	674	534[a]	320
1981	623	623[b]	116
1982	530	0[c]	530[d]
1983	690	0	690[b]
1984	472	392[a]	234
1985	443	443	75
1986	600	600	455
1987	525	525	328
1988	406	406	444
1989	326	326	80
1990	376	376	360
1991	241	241	241
1992	258	258	258
1993	380	380	287

a San Luis Reservoir reaches full storage even with the EWA export reductions and with SWP Article 21 water deliveries.
b The amount of EWA cost over 600,000 acre-feet would be covered by available CVPIA (b)(2) water and/or Variable EWA assets.
c 1982 & 1983 were very wet years. The water loss due to EWA required export pumping curtailments can be recovered by export pumping of Delta surplus flows during the summer months. The loss of unused CVP and SWP export pumping during the summer months would not affect any other water user or the CVP because no water purchases of water from the Upstream from the Delta Region by SWP contractors, the CVP on behalf of the Project's contractors, or transfer of upstream CVP stored water would be done in these very wet water years.
d This is pumping of Delta surplus water and not purchased water.

As discussed in Section 1.1, EWA assets are made up of variable operational assets, water purchased from the Upstream from the Delta Region, and water purchased from the Export Service Area. The amount of variable operational assets available is not known, although some amount of variable operational assets will be available in almost every year. The problem of not knowing the quantity of variable operational assets available is handled in the Proposed Action analyses (Maximum Water Purchase Scenario and Typical Water Purchase Scenario) by assuming that all assets will be developed through water purchases. This means that the environmental effects of more water purchases than will actually occur are analyzed because the amount of water available from variable operational asset would reduce the assumed water purchases. For, example, Table 12 shows that in three years (1988, 1991, and 1992) all of the required EWA assets for those years are produced from purchases from the Upstream from the Delta Region. In real-time operation, the amount of water required to be purchased from the Upstream from the Delta Region would be reduced by the amount of water available from those years' variable operational assets.

Another use of the variable operational assets is shown in 1981. In that year more than the assumed 600 TAF of assets would be required to implement the EWA actions. The additional assets would come from that year's variable operational assets.

<u>Typical Water Purchase Scenario</u>
The Typical Water Purchase Scenario is intended to characterize more typical EWA purchases in contrast to the Maximum Water Purchase Scenario. However, this scenario, like the Maximum Water Purchase Scenario, assumes that all unused Delta export pumping capacity for the summer months (July through September) would be available to the EWA Program. While this assumption permits evaluation of the potential worst-case for EWA export pumping, there are other water acquisition and transfer programs and SWP/CVP programs that have priority access to use this available pumping capacity. Therefore, this scenario does not necessarily represent the conditions that would be expected to occur for any given year of the program. The assumptions used in the Typical Water Purchase Scenario are as follows:

- It is anticipated that the EWA Program would only infrequently require 600 TAF of water to achieve fish protection objectives in the Delta.

- The EWA project agencies may not have the funding required in all years to develop 600 TAF of EWA assets.

- The actual purchases from the Upstream from the Delta Region are limited by available CVP and SWP unused export pumping capacity. The studies using the CALSIM II current demand benchmark studies (see Figure 1) show that the Projects have sufficient excess export capacity to pump 600 TAF only 15 percent of the time (based on an assessment of pooled seasonal export capacities for July through September for the years included in the study) during the 1922-1993 period of analysis, and that those occasions all occur in critically dry years. Studies also have shown that the EWA's greatest need for assets (from 400 TAF to 600 TAF) occurs during above normal and wet years and that during very dry years the EWA requires the least amount of water (200 TAF to 250 TAF) to achieve the fish protection objectives in the Delta. Therefore, it is more likely that the EWA need for as much as 600 TAF would occur when capability to export that water from the Delta is limited. Further, when the export capacity is available, the EWA would require a much smaller amount of water to achieve the EWA fish protection objectives in the Delta.

- Additionally, it is unlikely that all of the available unused CVP and SWP export pumping capacity would be available to the EWA Program as other projects and programs have priority access/use of the export capacity.

Assumptions for the Typical Water Purchase Scenario reflect EWA operations that are likely closer to how the EWA actually would be operated in the next few years. The water purchase assumptions for the Typical Water Purchase Scenario incorporate consideration of water year types, as listed shown below.

- In wet and above normal years, EWA assets would total 400 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 400 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.

- In below normal and dry years, except during the second dry year in a multi–year drought period, EWA assets would total 300 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 300 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.

- In the second dry year of a multi-year drought period and the first critical year to occur during a drought period, EWA assets would total 250 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 250 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.

- In critical water years that occur during drought periods other than the first critical year to occur in the drought, EWA assets would total 200 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 200 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.

The assumptions identified above will provide an estimate of the most likely fishery benefits that would be provided by the EWA Program considering implementation of EWA fish actions (generally between December and July) and summer pumping (July or August through September) of EWA water purchased from the Upstream from the Delta Region at the CVP and SWP pumping plants. The determination of net benefits considers the potential adverse effects of EWA exports during the summer that are then offset by the EWA fishery benefits achieved by pumping reductions during other times of the year.

Typical Water Purchase Scenario - Specific EWA Fish Actions

Table 13 shows the EWA actions and the reason for selecting each action assumed for the Typical Water Purchase Scenario.

Table 13
EWA Actions Simulated for the Typical Water Purchase Scenario

Water Year	Year Type	EWA Actions	Reason for Action
1979	Below Normal	Dec – Reduce export pumping by 10 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 10 TAF	Same as above
		Feb - Reduce export pumping by 20 TAF	Reduce spring and possibly winter-run Chinook salmon salvage. Also reduces adult delta smelt salvage.
		Mar -Reduce export pumping by 40 TAF	Reduce salvage of winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping by 30 TAF.	Reduce delta smelt salvage going into VAMP. Also reduces steelhead, splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 3,200 cfs export.	Implement VAMP study.
		May 16th – May 31st – Reduce export pumping to 5,500 cfs	Reduce delta smelt and splittail salvage.
		Jun - Reduce exports by 60 TAF	Reduce delta smelt and heavy splittail salvage.
1980	Above Normal	Dec – Reduce export pumping by 60 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage. Same as above plus reduce adult delta smelt salvage
		Jan - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook and splittail salvage
		Feb - Reduce export pumping by 30 TAF	Reduce winter-run Chinook salmon, and adult delta smelt salvage.
		Mar -Reduce export pumping by 20 TAF	Reduce winter-run Chinook salmon salvage
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs.	Reduce delta smelt salvage going into VAMP. Also reduces splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 3,200 cfs total pumping.	Implement VAMP study
		Jun - Reduce Banks P.P. export pumping to 1,500 cfs.	Reduce delta smelt and heavy splittail salvage
		Jul - Reduce export pumping by 1,500 cfs	Reduce delta smelt salvage
1981	Dry	Dec – Reduce export pumping by 20 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Feb - Reduce export pumping by 20 TAF	Reduce salvage of winter-run Chinook salmon, steelhead, and adult delta smelt salvage
		Mar -Reduce export pumping by 60 TAF	Reduce delta smelt, steelhead, splittail, and salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs.	Implement VAMP study
		April 15th – May 15th – VAMP @ 1,500 cfs export	Reduce delta smelt and heavy splittail salvage
		May 16th – 31st – Reduce export pumping to 4,000 cfs	Reduce delta smelt salvage
		Jun - Reduce export pumping by 30 TAF	Reduce delta smelt salvage
		Jul - Reduce export pumping by 30 TAF.	Reduce delta smelt salvage.

Table 13
EWA Actions Simulated for the Typical Water Purchase Scenario

Water Year	*Year Type*	*EWA Actions*	*Reason for Action*
1982	Wet	Dec – Reduce export pumping by 40 TAF	Export reductions may be required in Dec to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 40 TAF	Reduce spring-run salmon salvage.
		Feb - Reduce export pumping by 60 TAF	Reduce winter-run salmon, splittail, steelhead, and adult delta smelt salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter/spring-run salmon, steelhead and adult delta smelt salvage.
		Apr –Reduce export pumping by 120 TAF	Reduce heavy steelhead and salmon salvage
		May - Reduce export pumping by 120 TAF.	Reduce splittail, steelhead and salmon salvage
		Jun - Reduce export pumping by 90 TAF	Reduce delta smelt and splittail salvage
1983	Wet	Dec – Reduce export pumping by 150 TAF	Reduce heavy spring-run Chinook salmon salvage.
		Jan – Reduce export pumping by 120 TAF	Reduce spring-run salmon and adult delta smelt salvage
		Feb - Reduce export pumping by 120 TAF	Reduce run/winter-run salmon and adult delta smelt salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter/spring-run salmon, steelhead, and adult delta smelt salvage.
		Apr –Reduce export pumping by 60 TAF.	Reduce salmon salvage and heavy splittail salvage.
		May - Reduce export pumping by 60 TAF.	Reduce heavy splittail salvage and steelhead salvage.
		Jun - Reduce export pumping by 90 TAF	Reduce delta smelt and splittail salvage
1984	Wet	Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 6,000 cfs	Reduce splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 3,200 cfs export	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 4,000 cfs.	Reduce delta smelt and splittail salvage.
		Jun - Reduce export pumping by 90 TAF.	Reduce delta smelt and splittail salvage.
1985	Dry	Dec – Reduce export pumping by 30 TAF.	Reduce spring run Chinook salmon salvage
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage
		Mar -Reduce export pumping by 30 TAF	Reduce winter-run Chinook salmon, steelhead and splittail salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs	Reduce splittail and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,000 cfs	Reduce delta smelt and splittail salvage
		Jun 1st – Jun 15th - Reduce export pumping by 90 TAF.	Reduce heavy delta smelt and splittail salvage

Table 13 ***EWA Actions Simulated for the Typical Water Purchase Scenario***			
Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
1986	Wet	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Jan - Reduce export pumping by 30 TAF.	Reduce spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 90 TAF	Reduce spring-run salmon and adult delta smelt salvage
		Mar -Reduce export pumping by 90 TAF	Reduce splittail, steelhead, and winter-run salmon salvage.
		Apr - Reduce export pumping by 90 TAF	Reduce salmon, delta smelt and splittail salvage
		May - Reduce export pumping by 60 TAF.	Reduce delta smelt salvage and the heavy splittail salvage.
		Jun - Reduce export pumping by 60 TAF	Reduce delta smelt salvage and the heavy splittail salvage.
1987	Dry	Dec – Reduce export pumping by 20 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon salvage
		Mar -Reduce export pumping by 100 TAF	Reduce winter-run Chinook salmon salvage
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs	Reduce salvage of steelhead, and salmon salvage
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		Jun 1st – Jun 20th - Reduce export pumping by 70 TAF	Reduce delta smelt and splittail salvage
1988	Critical	Dec – Reduce export pumping by 60 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 30 TAF	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon salvage.
		Apr 1st –Apr 14th – reduce export pumping to 4,000 cfs.	Reduce salmon, delta smelt, and splittail salvage
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,500 cfs.	Reduce delta smelt and splittail salvage.
		Jun 1st – Jun 20th – Reduce export pumping by 30 TAF	Reduce delta smelt and splittail salvage.
1989	Dry	Dec – Reduce export pumping by 20 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF.	Same as above.
		Feb - Reduce export pumping by 30 TAF	Reduce spring-run Chinook salmon and adult delta smelt salvage.
		Mar -Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.

Table 13
EWA Actions Simulated for the Typical Water Purchase Scenario

Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
		April 15th – May 15th – VAMP @ 1,500 cfs export pumping	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 4,500 cfs	Reduce delta smelt and splittail salvage
		Jun – Reduce export pumping by 30 TAF	Reduce delta smelt and splittail salvage
1990	Critical	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, splittail, and adult delta smelt salvage
		Jun – Reduce export pumping to 1,500 cfs	Reduce delta smelt salvage
		Jul 1st – 15th – Reduce export pumping to 1,500 cfs	Reduce delta smelt salvage
1991	Critical	Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Apr 1st –Apr 14th – reduce export pumping to 1,500 cfs.	Reduce salmon, adult delta smelt, and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 2,500 cfs.	Reduce delta smelt and splittail salvage
		Jun – Reduce export pumping by 60 TAF	Reduce delta smelt and splittail salvage
1992	Critical	Jan - Reduce export pumping by 30 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 2,500 cfs	Reduce salmon salvage
		Apr 15th – Apr 30th – reduce export pumping to 1,500 cfs	Reduce salmon salvage
1993	Above Normal	Jan - Reduce export pumping by 20 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon, splittail, and steelhead salvage
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Apr 15th – May15th - VAMP @ 3,200 cfs export	Implement VAMP
		Jun 1st – 10th - Reduce export pumping to 6,000 cfs	Reduce delta smelt and splittail salvage

The Typical Water Purchase Scenario assumes that the EWA asset purchases would vary according to water year type and that those assets would be provided by water purchased from the Upstream from the Delta Region, limited only by available export pumping capacity at the CVP and SWP pumping plants. The export pumping of this purchased water starts on July 1st unless an EWA action occurs in July, or if it is determined that fish species of concern are observed within the Delta. In that case, export pumping of the purchased water does not start until the EWA action is completed. Table 14 displays the amount of export reductions due to the EWA actions shown in Table 13, the EWA cost due to the EWA actions, and the amount of purchased water pumped during the July through September period for each of the study year.

Table 14
Typical Water Purchase Scenario EWA Export Reductions, EWA Assets Required, and Water Purchase Pumping (TAF)

Analysis Year	Export Reductions	EWA Assets Required	Pumping of EWA Water at Banks and/or Tracy Pumping Plants
1979	341	271[a]	213
1980	560	430[a]	254
1981	348	348	116
1982	530	330[a]	282
1983	690	0[b]	690[c]
1984	370	290[4]	234
1985	326	326	75
1986	450	450	380
1987	290	290	290
1988	242	242	242
1989	256	256	120
1990	202	202	202
1991	210	210	210
1992	258	258	258
1993	242	242	242

a San Luis Reservoir reaches full storage even with the EWA export reductions and with SWP Article 21 water deliveries.
b 1982 & 1983 were very wet years. The water loss due to EWA required export pumping curtailments can be recovered by export pumping of Delta surplus flows during the summer months. The loss of unused CVP and SWP export pumping during the summer months would not affect any other water user or the CVP because no water purchases of water from the Upstream from the Delta Region by SWP contractors, the CVP on behalf of the Project's contractors, or transfer of upstream CVP stored water would be done in these very wet water years.
c This is pumping of Delta surplus water and not purchased water.

3.0 Sacramento-San Joaquin Delta – Fish Salvage/Benefit Analysis

The CVP and SWP facilities that pump water from the Delta can entrain and kill fish, some of which are Federally- and State-listed species. As described in Section 1, Introduction, of this document, the purpose of the EWA is to improve aquatic habitat conditions to protect and assist in the recovery of Delta-dependent fish species of concern through the management of EWA assets to reduce CVP/SWP Delta export pumping during periods critical to at-risk in-Delta fish species while also providing the CVP and SWP contractors and customers water supply reliability.

This section describes the methodology, assumptions, and results of the evaluation specifically developed to determine the potential benefits of implementing the EWA Proposed Action. This evaluation uses historical fish salvage data from the CVP and SWP pumping plants to evaluate the overall affect of 1) reducing Project exports on an annual basis, as determined appropriate during the months of December through June or July (EWA fish actions); and 2) changes in Delta exports (increased pumping) July through September to repay the Projects.

3.1 Salvage

Salvage is used as an indicator of fish loss resulting from SWP and CVP export operations from the south Delta. Salvage operations at the CVP and SWP export facilities (the John E. Skinner Fish Protection Facility and the Tracy Fish Collection Facility) are performed to reduce the number of fish adversely affected by entrainment (direct loss). Salvage estimates are defined as the number of fish entering a salvage facility and subsequently returned to the Delta through a trucking and release operation. Because survival of fish species sensitive to handling is believed to be low (delta smelt), increased salvage at these facilities is considered an adverse effect of an action or project upon fish resources.

3.2 Methodology

Salvage modeling was performed to develop an indication of the relative effect of the SWP and CVP pumping operations under the basis of comparison and with implementation of the Proposed Action. The evaluation uses historical fish salvage data from the CVP and SWP pumping plants to quantify the effect of the Proposed Action upon specific fish species in the Delta.

3.2.1 Historical Data

Historical salvage records provide data for delta smelt, Chinook salmon, steelhead, splittail salvage for both the SWP and CVP facilities. These data were used to develop estimates of salvage loss. The salvage data prior to 1979 does not sufficiently identify the fish species salvaged to allow an estimate of benefits for the key species of concern. Since 1979 the salvage data provides daily densities, in numbers of fish salvage per 1,000 acre-feet pumped at the SWP Banks Pumping Plant and the CVP Tracy Pumping Plant, for Chinook salmon, steelhead, Sacramento splittail, and delta smelt.

Data selected for use in these analyses extended over a 15-year period from 1979 to 1993. This period was selected based on consideration of the reliability of salvage data (e.g., accurate species identification, expansion calculations, etc.) and correspondence with the hydrologic model period used for the CALSIM II and related modeling applications that extends through 1993. This 15-year period also provides a range of water year conditions (e.g., wet, above normal, below normal, dry, and critical years).

3.2.2 Simulations/Assumptions

The CALSIM II study used for analyses in the EWA EIS/EIR provides an operational simulation of how the CVP and SWP would be operated if the historical hydrology were to repeat. The CALSIM II simulation encompasses the 1922 through 1993 period. Because usable historical salvage is only available beginning in 1979 and the last year of the CVP/SWP operational simulation is 1993, the study period for the Delta environmental effects analyses is necessarily 1979 to 1993.

Simulations are performed assuming 1) the 1979 through 1993 hydrologic period repeats; 2) the Projects are operated during this period utilizing the current system-wide water demand and regulatory requirements; and 3) the historical fish salvage that occurred during this period would occur again. Further, as described in Section 2.2.1.1, the CALSIM II benchmark study includes 2001 LOD (demands, facilities, infrastructure) and water allocation/regulatory standards.

3.2.2.1 Basis of Comparison

The basis of comparison for the evaluation of Delta fish salvage is taken from the CALSIM II benchmark study and related post-processing tools used to create the "virtual" CALSIM II output database specifically for the 15-year period of record (1979 to 1993).

3.2.2.2 Proposed Action (Flexible Purchase Alternative)

The Proposed Action (Flexible Purchase Alternative) for the evaluation of Delta fish salvage is taken from the CALSIM II benchmark study as modified by post-processing applications to incorporate implementation of the EWA Program. Specifically, the 15-year period of record, 1979 to 1993 is used for the determination of EWA Program affects upon salvage.

As described in Section 2.2.2.2, EWA water asset acquisitions were examined under two different scenarios 1) Maximum Water Purchase Scenario; and 2) Typical Water Purchase Scenario.

3.2.3 Salvage Calculations

Calculations of salvage loss at the SWP and CVP, as a function of changes in the seasonal volume of water diverted, have been used as an indicator of potential effects resulting from changes in water project operations. The magnitude of direct losses resulting from export operations is a function of the magnitude of monthly water exports from each facility and the density (number per acre-foot) of fish vulnerable to entrainment at the facilities. Results of the hydrologic modeling performed for the basis of comparison and the Proposed Action scenarios provide estimates of the average monthly Delta export operations for both the SWP and CVP. Salvage data are available on species-specific level at both the SWP and CVP facilities for use in estimating the risk of fishery loss. Average densities (number per acre-foot) were calculated monthly for both the SWP and CVP facilities for selected fish species over a 15-year period (1979 to 1993). Estimates of direct loss from SWP and CVP facilities were calculated for Chinook salmon, steelhead, delta smelt, splittail.

An index of salvage was developed for the purposes of evaluating the incremental effects of EWA operations on the direct losses at the Delta export facilities. The salvage index was derived using records of species-specific salvage data at the SWP and CVP to calculate average monthly density (number of fish per TAF), which could then be multiplied by the calculated SWP and CVP monthly exports (in TAF) obtained from the hydrologic modeling output. The salvage index was calculated separately for the SWP and CVP export operations under the basis of comparison and Proposed Action. The resulting salvage index was then used to determine the incremental benefits (reduced salvage) and adverse effects (increased salvage) calculated to result from EWA operations.

Average monthly salvage densities for each species were calculated from daily salvage records over the period from 1979 through 2001 (R. Brown, unpublished data; CDFG, unpublished data). Based on the daily salvage, expanded for sub-sampling effort, a daily density estimate was calculated using the actual water volume diverted at each of the two export facilities. The daily density estimates were then averaged to calculate an average monthly density. For consistency, the average monthly density of each of the individual target species was then used to calculate the salvage index for the period from January 1979 through September 1993 using hydrologic modeling results for the basis of comparison and Proposed Action (Flexible Purchase Alternative). After calculating the monthly salvage index for each species, assuming EWA operations, the baseline estimate was subtracted from the monthly salvage index for each species to determine the net difference in salvage estimates (EWA operations - baseline estimate = net change) that are anticipated to occur with implementation of the Proposed Action. These calculations were performed for both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario.

3.2.4 Limitations

It is recognized that during the historical period, 1979 to 1993, the Projects were operated under Delta water quality, flow, and export constraint requirements that were much less stringent than the Delta requirements in place today. This suggests that the historical fish salvage was likely higher than it would be if the 1979 to 1993 period reoccurred with the Projects operated under today's Delta requirements, as assumed in this analysis. As a result, the Delta effects analyzed in this document likely will over-estimate the amount of EWA assets required to achieve the State and Federal fishery agencies' habitat conditions improvement goals.

The current populations of some of the listed species, such as winter-run Chinook salmon, are larger today than they were during the 1979 to 1993 period. Because of this, neither the timing, duration, nor the quantity of water needed for most operational curtailments can be accurately estimated until shortly before the action is scheduled. Differences in conditions between the historical 1979 to 1993 period and what would occur if that hydrologic period reoccurred today, indicate that the historical fish salvage at the Projects' pumping plants that occurred during the 1979 to 1993 period would not be the same today.

However, despite the inaccuracies within the analyses caused by assuming historical fish salvage at the pumping plants, the evaluations were performed to provide some approximate quantification of the overall potential EWA benefits that may be realized with implementation of the EWA program, using the best available data. Without some quantification, the discussion and analysis of benefits of the EWA and the cost of exporting water would have to be qualitative and based upon scientific opinion. Therefore, the results provided by the analyses must be considered as only part of the information (quantitative and qualitative) that should be used to evaluate the effects of implementing the EWA in the Delta.

3.2.5 Effect Analysis Comparisons

The results for the Maximum Water Purchase Scenario under the Proposed Action (Flexible Purchase Alternative) were compared to the basis of comparison to determine the overall maximum net benefits that may result from implementation of the EWA program. These results are described in Section 3.2.6.1 and in Chapter 9 of the EWA EIS/EIR, and Chapter 4 of the ASIP.

Additionally, the results for the Proposed Action (Flexible Purchase Alternative), under the Typical Water Purchase Scenario were compared to the basis of comparison to determine the overall, more likely, net benefits that may result from implementation of the EWA program.

These results are described in Section 3.2.6.2 and in Chapter 9 of the EWA EIS/EIR, and Chapter 4 of the ASIP.

3.2.6 Results

The results from the evaluation of each scenario, summarized in the following sections, indicate that implementation of the EWA fish actions would result in overall long-term net benefits to the fish species of concern in the Delta Region, relative to the basis of comparison. A more detailed presentation of overall net benefits to the individual species is presented in Chapter 9 of the EWA EIS/EIR and Chapter 4 of the ASIP.

For the purposes of evaluating potential effects of the EWA program on fish salvage, the incremental difference in the annual salvage indices reflect the benefit (reduced salvage under the EWA Program) as a negative index and an incremental adverse effect (increased salvage under the EWA Program) as a positive index.

3.2.6.1 Maximum Water Purchase Scenario – EWA Benefits

The salvage modeling indicates that the Maximum Water Purchase Scenario would result in overall net benefits as determined by estimated reductions in salvage loss, as presented in Tables 15 through 26 for Chinook salmon, delta smelt, Sacramento splittail, and steelhead. It is noted that the values provided in these tables indicate the maximum possible salvage benefits based on the assumptions for this scenario (described in Section 2.2.2.2). Therefore, these results represent an upper boundary for the level of benefit that could occur with implementation of the proposed EWA fish actions.

Three tables are shown for each species. The first table shows the salvage for the basis of comparison (Baseline Condition), the second table is an intermediate step that shows the reduction in the base salvage after the assumed EWA pump reductions are implemented, and the third table shows the overall net result of the combined influences from the assumed EWA pump reductions and the increased summer Delta export pumping to repay SWP and CVP customers.

The EWA provides benefits to all fish species studied during the 1979 to 1993 study period. There are two years when the EWA does not result in a net decrease of salvage for listed species. However, it is noted that, in real-time operations, if fish species of concern were observed near the pumps, the Management Agencies could avoid effects by delaying the start of summer export pumping until it is determined the fish are out of the area, or until the EWA fish action is completed.

Table 15 ***Delta Smelt Salvage (Baseline Condition)***													
Year	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1979				4,263	5,501	3,901	1,966	9,079	15,466	12,250	3,413	83	55,923
1980	25,751	1,300	0	6,540	5,479	10,622	2,307	989	19,170	15,604	11,530	2,251	101,543
1981	16,254	3,914	11,500	29,526	25,537	14,389	3,750	80,903	66,163	114,229	55,870	4,268	426,301
1982	2,757	9,008	1,356	12,822	12,371	5,945	297	529	2,946	868	2,380	1,907	53,188
1983	1,469	1,505	922	2,130	798	323	40	12	7,775	6,241	0	1,195	22,412
1984	0	0	426	0	74	1,005	125	15,533	9,276	2,762	875	48	30,125
1985	210	135	3,161	316	675	417	697	2,664	10,745	3,942	2,228	1,264	26,454
1986	77	0	569	1,688	3,276	928	720	137	198	265	1,366	0	9,225
1987	194	35	232	120	1,137	760	8,384	7,787	11,721	2,590	3,339	342	36,641
1988	54	31	8,533	7,077	335	15	0	7,901	7,452	658	0	0	32,056
1989	141	0	272	797	24	307	2,494	2,076	5,986	9,065	1,304	412	22,878
1990	109	138	0	256	204	173	952	2,706	23,168	3,393	28	0	31,126
1991	0	0	47	388	209	1,372	450	1,450	2,708	2,463	980	1,264	11,332
1992	101	0	0	99	871	636	101	494	637	17	0	0	2,954
1993	0	0	0	3,118	1,822	444	0	37,725	24,146	647	25	0	67,925
Total	47,119	16,065	27,018	69,141	58,312	41,236	22,283	169,983	207,557	174,996	83,339	13,034	930,082

Table 16 ***Change in Delta Smelt Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)***													
Year	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1979				-125	-188	-337	-1,350	-3,121	-2,440	0	0	0	-7,561
1980	0	0	0	-188	-348	-408	-816	-238	-9,006	-4,752	0	0	-15,754
1981	0	0	-416	0	-1,128	-6,552	-1,522	-37,501	-3,836	-15,305	0	0	-66,261
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	0	0	0	-3,062
1983	0	0	-161	-862	-254	-61	-10	-8	-2,932	0	0	0	-4,288
1984	0	0	0	0	-2	-186	-50	-5,046	-1,553	0	0	0	-6,838
1985	0	0	-340	0	-30	-57	-282	-456	-7,955	0	0	0	-9,120
1986	0	0	-20	-71	-356	-241	-128	-26	-39	0	0	0	-881
1987	0	0	-22	-5	-53	-357	-3,402	-3,886	-5,925	-901	0	0	-14,552
1988	0	0	-1,337	-862	-100	0	0	-4,816	0	0	0	0	-7,115
1989	0	0	0	-44	-6	-32	-40	-366	-581	-1,884	0	0	-2,953
1990	0	0	0	-27	-80	-56	0	0	-7,656	0	0	0	-7,819
1991	0	0	0	0	0	-213	-121	-857	0	0	0	0	-1,191
1992	0	0	0	-10	-102	-164	-20	0	0	0	0	0	-295
1993	0	0	0	-89	-59	-49	0	-5,389	-1,681	0	0	0	-7,268
Total	0	0	-2,358	-3,063	-3,964	-9,347	-7,814	-61,929	-43,642	-22,842	0	0	-154,959

Table 17
Change in Delta Smelt Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-125	-188	-337	-1,350	-3,121	-2,440	2,463	181	15	-4,902
1980	0	0	0	-188	-348	-408	-816	-238	-9,006	915	3,314	105	-6,668
1981	0	0	-416	0	-1,128	-6,552	-1,522	-37,501	-3,836	-15,305	235	24	-66,002
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,932	852	0	245	-3,191
1984	0	0	0	0	-2	-186	-50	-5,046	-1,553	761	3	9	-6,065
1985	0	0	-340	0	-30	-57	-282	-456	-7,955	63	34	50	-8,973
1986	0	0	-20	-71	-356	-241	-128	-26	-39	112	166	0	-603
1987	0	0	-22	-5	-53	-357	-3,402	-3,886	-5,925	-892	75	150	-14,319
1988	0	0	-1,337	-862	-100	0	0	-4,816	0	418	0	0	-6,697
1989	0	0	0	-44	-6	-32	-40	-366	-581	-1,884	74	31	-2,848
1990	0	0	0	-27	-80	-56	0	0	-7,656	960	2	0	-6,857
1991	0	0	0	0	0	-213	-121	-857	0	880	261	448	398
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-89	-59	-49	0	-5,389	-1,681	293	5	0	-6,970
Total	0	0	-2,358	-3,063	-3,964	-9,347	-7,814	-61,929	-43,642	-9,651	4,763	1,117	-135,887

Table 18
Steelhead Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				649	1,181	1,979	2,392	1,041	0	0	0	0	7,242
1980	0	16	33	519	911	173	966	897	108	0	0	0	3,623
1981	74	0	320	495	3,299	7,139	3,155	205	0	0	0	0	14,687
1982	0	0	686	1,691	2,040	1,027	10,063	7,644	1,647	0	0	0	24,799
1983	24	0	1,985	108	40	0	0	466	0	0	0	0	2,624
1984	0	36	0	0	0	184	400	66	0	0	0	0	685
1985	0	0	31	0	395	1,069	793	471	0	0	0	0	2,759
1986	0	0	0	21	932	257	2,095	711	34	32	0	0	4,082
1987	0	0	1,450	150	215	8,628	1,229	243	0	0	0	0	11,915
1988	0	0	589	363	485	179	1,097	686	2	0	0	0	3,401
1989	0	0	110	32	145	10,533	3,465	493	0	0	0	0	14,777
1990	0	0	0	0	1,472	2,228	196	82	0	0	0	0	3,979
1991	0	0	18	74	79	11,261	905	105	0	0	0	0	12,441
1992	25	292	0	4,550	7,920	4,869	342	14	0	0	0	0	18,011
1993	0	0	14	1,356	14,819	7,001	1,268	738	40	0	0	0	25,236
Total	123	344	5,235	10,008	33,933	56,527	28,364	13,861	1,832	32	0	0	150,260

Table 19
Change in Steelhead Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-34	-93	-260	-1,425	-775	0	0	0	0	-2,588
1980	0	0	-2	-15	-48	-7	-738	-671	-55	0	0	0	-1,536
1981	0	0	-12	0	-132	-2,397	-1,452	-92	0	0	0	0	-4,085
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-261	-8	0	0	0	0	-293
1985	0	0	-2	0	-18	-145	-353	-163	0	0	0	0	-682
1986	0	0	0	-2	-144	-71	-423	-182	0	0	0	0	-820
1987	0	0	-138	-9	-12	-2,715	-546	-81	0	0	0	0	-3,500
1988	0	0	-83	-55	-189	0	-164	-170	0	0	0	0	-661
1989	0	0	0	-2	-42	-1,464	-34	-26	0	0	0	0	-1,568
1990	0	0	0	0	-383	-846	0	0	0	0	0	0	-1,230
1991	0	0	0	0	0	-1,988	-206	-31	0	0	0	0	-2,225
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-39	-588	-928	-395	-314	0	0	0	0	-2,264
Total	0	0	-1,024	-550	-2,810	-12,182	-7,826	-4,114	-428	0	0	0	-28,934

Table 20
Change in Steelhead Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-34	-93	-260	-1,425	-775	0	0	0	0	-2,588
1980	0	0	-2	-15	-48	-7	-738	-671	-55	0	0	0	-1,536
1981	0	0	-12	0	-132	-2,397	-1,452	-92	0	0	0	0	-4,085
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-261	-8	0	0	0	0	-293
1985	0	0	-2	0	-18	-145	-353	-163	0	0	0	0	-682
1986	0	0	0	-2	-144	-71	-423	-182	0	5	0	0	-815
1987	0	0	-138	-9	-12	-2,715	-546	-81	0	0	0	0	-3,500
1988	0	0	-83	-55	-189	0	-164	-170	0	0	0	0	-661
1989	0	0	0	-2	-42	-1,464	-34	-26	0	0	0	0	-1,568
1990	0	0	0	0	-383	-846	0	0	0	0	0	0	-1,230
1991	0	0	0	0	0	-1,988	-206	-31	0	0	0	0	-2,225
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-39	-588	-928	-395	-314	0	0	0	0	-2,264
Total	0	0	-1,024	-550	-2,810	-12,182	-7,826	-4,114	-428	5	0	0	-28,928

Table 21 Chinook Salmon Salvage (Baseline Condition)													
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				15,754	5,111	6,669	78,404	100,415	10,579	5,236	439	338	222,946
1980	2,244	6,431	6,700	8,308	470	498	119,475	93,503	40,724	1,976	32	1,690	282,050
1981	3,124	2,563	3,148	3,137	5,138	15,279	44,955	28,292	4,639	0	83	0	110,360
1982	6,466	5,712	33,275	25,872	42,724	34,027	31,819	290,241	137,177	1,643	224	0	609,180
1983	0	32,194	75,216	8,684	9,719	6,530	27,102	30,693	108,466	2,819	0	0	301,422
1984	3,695	1,095	51	219	175	8,615	82,697	95,424	75,191	1,019	536	0	268,716
1985	28,854	23,118	19,885	350	8,481	5,379	40,758	97,778	13,600	661	0	30	238,892
1986	8,953	4,225	6,249	3,707	541,376	92,284	286,376	260,372	196,795	7,221	0	0	1,407,557
1987	707	187	1,388	516	1,490	12,384	41,486	40,467	8,798	580	84	89	108,176
1988	3	17	32,416	7,207	3,037	633	15,334	36,453	2,425	363	18	9	97,915
1989	41	466	709	2,139	35	15,568	17,357	32,969	2,361	0	125	0	71,771
1990	24	254	63	2,817	464	2,282	1,796	18,052	4,116	6	0	0	29,873
1991	7	0	23	31	115	8,028	13,816	19,395	863	0	0	0	42,278
1992	18	4,990	138	1,315	13,624	21,902	17,320	2,621	0	0	0	6	61,934
1993	0	0	199	1,743	1,726	946	8,935	18,233	3,823	3	96	0	35,705
Total	54,135	81,253	179,459	81,799	633,686	231,025	827,631	1,164,908	609,555	21,526	1,637	2,161	3,888,774

Table 22 Change in Chinook Salmon Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)													
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-586	-197	-700	-55,499	-55,646	-1,570	0	0	0	-114,198
1980	0	0	-466	-238	-27	-20	-86,314	-54,922	-16,405	-567	0	0	-158,960
1981	0	0	-102	0	-156	-5,630	-24,295	-15,608	-64	0	0	0	-45,854
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	0	0	0	-103,981
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-37,634	0	0	0	-88,473
1984	0	0	0	0	-6	-1,290	-45,834	-46,789	-16,714	0	0	0	-110,633
1985	0	0	-1,625	0	-362	-829	-16,828	-48,989	-10,555	0	0	0	-79,187
1986	0	0	-399	-190	-93,319	-25,239	-57,136	-86,099	-59,386	0	0	0	-321,769
1987	0	0	-94	-27	-78	-4,394	-16,697	-11,139	-4,062	0	0	0	-36,491
1988	0	0	-4,804	-1,015	-913	0	-1,902	-14,700	0	0	0	0	-23,333
1989	0	0	0	-118	-9	-2,071	-770	-6,591	-148	0	0	0	-9,706
1990	0	0	-51	-298	-164	-744	0	0	-1,273	0	0	0	-2,531
1991	0	0	0	0	0	-1,355	-3,919	-7,895	0	0	0	0	-13,169
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,548
1993	0	0	0	-51	-67	-122	-4,429	-4,236	-238	0	0	0	-9,144
Total	0	0	-25,617	-7,383	-103,545	-53,091	-329,762	-444,219	-163,792	-567	0	0	-1,127,976

Table 23
Change in Chinook Salmon Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-586	-197	-700	-55,499	-55,646	-1,570	1,450	75	28	-112,645
1980	0	0	-466	-238	-27	-20	-86,314	-54,922	-16,405	-567	10	519	-158,431
1981	0	0	-102	0	-156	-5,630	-24,295	-15,608	-64	0	14	0	-45,839
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-37,634	284	0	0	-88,189
1984	0	0	0	0	-6	-1,290	-45,834	-46,789	-16,714	4	133	0	-110,496
1985	0	0	-1,625	0	-362	-829	-16,828	-48,989	-10,555	29	0	2	-79,156
1986	0	0	-399	-190	-93,319	-25,239	-57,136	-86,099	-59,386	1,244	0	0	-320,526
1987	0	0	-94	-27	-78	-4,394	-16,697	-11,139	-4,062	15	2	3	-36,471
1988	0	0	-4,804	-1,015	-913	0	-1,902	-14,700	0	248	21	2	-23,062
1989	0	0	0	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,701
1990	0	0	-51	-298	-164	-744	0	0	-1,273	1	0	0	-2,529
1991	0	0	0	0	0	-1,355	-3,919	-7,895	0	0	0	0	-13,169
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-51	-67	-122	-4,429	-4,236	-238	2	21	0	-9,120
Total	0	0	-25,617	-7,383	-103,545	-53,091	-329,762	-444,219	-163,792	2,742	286	555	-1,123,826

Table 24
Splittail Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				34	1,122	4,615	2,157	60,479	70,254	15,807	5,254	1,202	160,925
1980	72	86	1,310	56,194	61,187	1,621	6,020	140,563	187,723	45,984	9,770	1,318	511,847
1981	265	0	598	1,557	8,581	5,781	5,242	64,198	27,671	2,539	1,203	0	117,636
1982	0	290	1,577	32,429	44,207	13,705	5,413	45,730	169,164	193,840	121,238	4,172	631,762
1983	227	0	2,409	1,164	13,451	4,668	2,082	16,054	304,327	112,646	55,782	5,300	518,109
1984	1,477	36	63	96	3,945	7,479	5,640	9,307	56,464	46,887	10,337	1,060	142,790
1985	0	396	1,989	282	8,360	4,514	3,851	3,219	25,057	14,605	4,072	758	67,103
1986	286	1,103	0	246	2,281	7,461	74,203	971,878	1,095,083	29,690	14,404	7,452	2,204,087
1987	1,094	418	976	1,411	4,854	6,291	1,443	1,466	107,463	7,716	939	350	134,422
1988	34	13	3,581	23,499	3,589	638	1,901	2,999	2,434	1,268	20	168	40,145
1989	0	129	77	485	265	10,674	7,193	9,775	7,567	4,449	10,305	1,409	52,328
1990	49	48	7	1,279	1,932	3,197	322	3,224	11,623	1,071	0	0	22,752
1991	0	0	0	491	133	7,132	2,673	2,265	10,196	843	0	0	23,733
1992	78	0	25	485	4,324	3,247	181	244	2,508	0	88	3	11,183
1993	0	0	12	34,322	11,430	3,110	2,718	74,866	112,327	10,923	482	82	250,270
Total	3,581	2,519	12,623	153,974	169,661	84,134	121,038	1,406,268	2,189,862	488,266	233,894	23,273	4,889,093

Table 25
Change in Splittail Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-1	-38	-398	-1,479	-9,931	-10,819	0	0	0	-22,666
1980	0	0	-91	-1,613	-3,254	-69	-4,310	-23,974	-66,341	-6,029	0	0	-105,683
1981	0	0	-20	0	-299	-1,819	-2,823	-29,018	0	0	0	0	-33,980
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	0	0	0	-40,821
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-59,762	0	0	0	-75,452
1984	0	0	0	0	-218	-1,114	-2,807	-2,315	-3,868	0	0	0	-10,323
1985	0	0	-138	0	-371	-677	-1,662	-700	-14,563	0	0	0	-18,112
1986	0	0	0	-10	-356	-2,094	-16,567	-368,329	-339,879	0	0	0	-727,235
1987	0	0	-89	-74	-268	-2,357	-642	-373	-54,289	-666	0	0	-58,758
1988	0	0	-518	-2,602	-1,315	0	-259	-1,378	0	0	0	0	-6,072
1989	0	0	0	-32	-83	-1,351	-104	-2,308	-670	-994	0	0	-5,542
1990	0	0	-6	-132	-757	-1,192	0	0	0	0	0	0	-2,087
1991	0	0	0	0	0	-1,337	-648	-1,329	0	0	0	0	-3,314
1992	0	0	0	-35	-642	-839	-22	0	0	0	0	0	-1,537
1993	0	0	0	-1,439	-457	-448	-1,459	-2,489	-2,114	0	0	0	-8,407
Total	0	0	-1,673	-7,675	-15,292	-16,502	-34,572	-460,681	-575,902	-7,690	0	0	-1,119,988

Table 26
Change in Splittail Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-1	-38	-398	-1,479	-9,931	-10,819	2,979	778	71	-18,838
1980	0	0	-91	-1,613	-3,254	-69	-4,310	-23,974	-66,341	46	2,198	341	-97,068
1981	0	0	-20	0	-299	-1,819	-2,823	-29,018	0	0	16	0	-33,963
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-59,762	9,261	4,804	194	-61,192
1984	0	0	0	0	-218	-1,114	-2,807	-2,315	-3,868	8,776	1,941	208	603
1985	0	0	-138	0	-371	-677	-1,662	-700	-14,563	383	78	20	-17,630
1986	0	0	0	-10	-356	-2,094	-16,567	-368,329	-339,879	22,726	3,675	1,748	-699,086
1987	0	0	-89	-74	-268	-2,357	-642	-373	-54,289	-436	96	106	-58,326
1988	0	0	-518	-2,602	-1,315	0	-259	-1,378	0	1,178	24	47	-4,824
1989	0	0	0	-32	-83	-1,351	-104	-2,308	-670	-994	455	79	-5,008
1990	0	0	-6	-132	-757	-1,192	0	0	0	1,459	0	0	-628
1991	0	0	0	0	0	-1,337	-648	-1,329	0	459	0	0	-2,855
1992	0	0	0	-35	-642	-839	-22	0	0	0	55	0	-1,482
1993	0	0	0	-1,439	-457	-448	-1,459	-2,489	-2,114	675	89	16	-7,627
Total	0	0	-1,673	-7,675	-15,292	-16,502	-34,572	-460,681	-575,902	60,415	34,596	2,996	-1,014,290

3.2.6.2 *Typical Water Purchase Scenario – EWA Benefits*

The calculation of the EWA benefits for the Typical Water Purchase Scenario are shown in Tables 27 through 38 for delta smelt, steelhead, Chinook salmon, Sacramento splittail. Three tables are shown for each species. The first table shows the salvage under the Baseline Condition; the second table shows reduced base salvage after the assumed EWA pump reductions are implemented, and the third table shows the overall net affect on base salvage with the assumed EWA pump reduction and the increase in summer export pumping of the EWA assets. As indicated by these results for the analysis period, 1979 to 1993, the Typical Water Purchase Scenario would result in a net beneficial effect as measured by estimated annual net salvage data. These results indicate that the EWA provides net benefits to all fish species studied. Changes in salvage estimates are indicated for each year for each species. Additional species-specific discussions of these results are provided in Chapter 9 of the EWA EIS/EIR and in Chapter 4 of the ASIP.

Table 27
Delta Smelt Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				4,263	5,501	3,901	1,966	9,079	15,466	12,250	3,413	83	55,923
1980	25,751	1,300	0	6,540	5,479	10,622	2,307	989	19,170	15,604	11,530	2,251	101,543
1981	16,254	3,914	11,500	29,526	25,537	14,389	3,750	80,903	66,163	114,229	55,870	4,268	426,301
1982	2,757	9,008	1,356	12,822	12,371	5,945	297	529	2,946	868	2,380	1,907	53,188
1983	1,469	1,505	922	2,130	798	323	40	12	7,775	6,241	0	1,195	22,412
1984	0	0	426	0	74	1,005	125	15,533	9,276	2,762	875	48	30,125
1985	210	135	3,161	316	675	417	697	2,664	10,745	3,942	2,228	1,264	26,454
1986	77	0	569	1,688	3,276	928	720	137	198	265	1,366	0	9,225
1987	194	35	232	120	1,137	760	8,384	7,787	11,721	2,590	3,339	342	36,641
1988	54	31	8,533	7,077	335	15	0	7,901	7,452	658	0	0	32,056
1989	141	0	272	797	24	307	2,494	2,076	5,986	9,065	1,304	412	22,878
1990	109	138	0	256	204	173	952	2,706	23,168	3,393	28	0	31,126
1991	0	0	47	388	209	1,372	450	1,450	2,708	2,463	980	1,264	11,332
1992	101	0	0	99	871	636	101	494	637	17	0	0	2,954
1993	0	0	0	3,118	1,822	444	0	37,725	24,146	647	25	0	67,925
Total	47,119	16,065	27,018	69,141	58,312	41,236	22,283	169,983	207,557	174,996	83,339	13,034	930,082

Table 28
Change in Delta Smelt Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-42	-125	-225	-442	-1,874	-2,440	0	0	0	-5,148
1980	0	0	0	-188	-348	-408	-498	-127	-6,754	-8,217	0	0	-16,540
1981	0	0	-416	0	-1,128	-1,966	-1,036	-13,130	-3,836	-5,102	0	0	-26,614
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	0	0	0	-3,062
1983	0	0	-161	-862	-254	-61	-10	-8	-2,199	0	0	0	-3,555
1984	0	0	0	0	-2	-186	-21	-2,895	-1,165	0	0	0	-4,269
1985	0	0	-170	0	-30	-29	-255	-906	-6,524	0	0	0	-7,912
1986	0	0	-20	-71	-356	-145	-128	-18	-19	0	0	0	-756
1987	0	0	-15	0	-35	-208	-1,301	-3,886	-5,925	0	0	0	-11,371
1988	0	0	-668	-287	-35	0	0	-4,816	-487	0	0	0	-6,293
1989	0	0	-21	-44	-6	-32	-40	-366	-581	0	0	0	-1,090
1990	0	0	0	-9	-27	-28	0	-28	-7,656	0	0	0	-7,748
1991	0	0	0	0	0	-106	-121	-531	-2,708	0	0	0	-3,467
1992	0	0	0	-10	-102	-164	-20	0	0	0	0	0	-295
1993	0	0	0	-60	-59	-33	0	-7,318	-1,022	0	0	0	-8,491
Total	0	0	-1,533	-2,352	-3,765	-4,223	-3,945	-36,121	-41,354	-13,319	0	0	-106,611

Table 29
Change in Delta Smelt Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-42	-125	-225	-442	-1,874	-2,440	2,463	181	15	-2,489
1980	0	0	0	-188	-348	-408	-498	-127	-6,754	-8,217	3,314	105	-13,121
1981	0	0	-416	0	-1,128	-1,966	-1,036	-13,130	-3,836	-5,102	235	24	-26,355
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,199	852	0	245	-2,458
1984	0	0	0	0	-2	-186	-21	-2,895	-1,165	761	3	9	-3,496
1985	0	0	-170	0	-30	-29	-255	-906	-6,524	63	34	50	-7,765
1986	0	0	-20	-71	-356	-145	-128	-18	-19	91	104	0	-561
1987	0	0	-15	0	-35	-208	-1,301	-3,886	-5,925	-19	-21	132	-11,279
1988	0	0	-668	-287	-35	0	0	-4,816	-487	290	0	0	-6,004
1989	0	0	-21	-44	-6	-32	-40	-366	-581	441	74	31	-543
1990	0	0	0	-9	-27	-28	0	-28	-7,656	136	0	0	-7,612
1991	0	0	0	0	0	-106	-121	-531	-2,708	1,240	368	277	-1,582
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-60	-59	-33	0	-7,318	-1,022	250	5	0	-8,237
Total	0	0	-1,533	-2,352	-3,765	-4,223	-3,945	-36,121	-41,354	-6,036	4,711	928	-93,690

Table 30
Steelhead Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				649	1,181	1,979	2,392	1,041	0	0	0	0	7,242
1980	0	16	33	519	911	173	966	897	108	0	0	0	3,623
1981	74	0	320	495	3,299	7,139	3,155	205	0	0	0	0	14,687
1982	0	0	686	1,691	2,040	1,027	10,063	7,644	1,647	0	0	0	24,799
1983	24	0	1,985	108	40	0	0	466	0	0	0	0	2,624
1984	0	36	0	0	0	184	400	66	0	0	0	0	685
1985	0	0	31	0	395	1,069	793	471	0	0	0	0	2,759
1986	0	0	0	21	932	257	2,095	711	34	32	0	0	4,082
1987	0	0	1,450	150	215	8,628	1,229	243	0	0	0	0	11,915
1988	0	0	589	363	485	179	1,097	686	2	0	0	0	3,401
1989	0	0	110	32	145	10,533	3,465	493	0	0	0	0	14,777
1990	0	0	0	0	1,472	2,228	196	82	0	0	0	0	3,979
1991	0	0	18	74	79	11,261	905	105	0	0	0	0	12,441
1992	25	292	0	4,550	7,920	4,869	342	14	0	0	0	0	18,011
1993	0	0	14	1,356	14,819	7,001	1,268	738	40	0	0	0	25,236
Total	123	344	5,235	10,008	33,933	56,527	28,364	13,861	1,832	32	0	0	150,260

Table 31
Change in Steelhead Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-11	-62	-173	-707	-473	0	0	0	0	-1,428
1980	0	0	-2	-15	-48	-7	-507	-458	-41	0	0	0	-1,078
1981	0	0	-12	0	-132	-719	-1,016	-24	0	0	0	0	-1,903
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-151	-5	0	0	0	0	-180
1985	0	0	-1	0	-18	-73	-220	-221	0	0	0	0	-532
1986	0	0	0	-2	-144	-43	-423	-121	0	0	0	0	-732
1987	0	0	-92	0	-8	-1,213	-302	-81	0	0	0	0	-1,695
1988	0	0	-42	-18	-103	0	-78	-170	0	0	0	0	-411
1989	0	0	-5	-2	-42	-1,464	-34	-26	0	0	0	0	-1,573
1990	0	0	0	0	-128	-423	0	-3	0	0	0	0	-554
1991	0	0	0	0	0	-994	-206	-24	0	0	0	0	-1,224
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-26	-588	-618	-165	-200	0	0	0	0	-1,597
Total	0	0	-941	-468	-2,434	-7,088	-5,636	-3,407	-414	0	0	0	-20,389

Table 32
Change in Steelhead Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-11	-62	-173	-707	-473	0	0	0	0	-1,428
1980	0	0	-2	-15	-48	-7	-507	-458	-41	0	0	0	-1,078
1981	0	0	-12	0	-132	-719	-1,016	-24	0	0	0	0	-1,903
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-151	-5	0	0	0	0	-180
1985	0	0	-1	0	-18	-73	-220	-221	0	0	0	0	-532
1986	0	0	0	-2	-144	-43	-423	-121	0	3	0	0	-728
1987	0	0	-92	0	-8	-1,213	-302	-81	0	0	0	0	-1,695
1988	0	0	-42	-18	-103	0	-78	-170	0	0	0	0	-411
1989	0	0	-5	-2	-42	-1,464	-34	-26	0	0	0	0	-1,573
1990	0	0	0	0	-128	-423	0	-3	0	0	0	0	-554
1991	0	0	0	0	0	-994	-206	-24	0	0	0	0	-1,224
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-26	-588	-618	-165	-200	0	0	0	0	-1,597
Total	0	0	-941	-468	-2,434	-7,088	-5,636	-3,407	-414	3	0	0	-20,386

Table 33
Chinook Salmon Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				15,754	5,111	6,669	78,404	100,415	10,579	5,236	439	338	222,946
1980	2,244	6,431	6,700	8,308	470	498	119,475	93,503	40,724	1,976	32	1,690	282,050
1981	3,124	2,563	3,148	3,137	5,138	15,279	44,955	28,292	4,639	0	83	0	110,360
1982	6,466	5,712	33,275	25,872	42,724	34,027	31,819	290,241	137,177	1,643	224	0	609,180
1983	0	32,194	75,216	8,684	9,719	6,530	27,102	30,693	108,466	2,819	0	0	301,422
1984	3,695	1,095	51	219	175	8,615	82,697	95,424	75,191	1,019	536	0	268,716
1985	28,854	23,118	19,885	350	8,481	5,379	40,758	97,778	13,600	661	0	30	238,892
1986	8,953	4,225	6,249	3,707	541,376	92,284	286,376	260,372	196,795	7,221	0	0	1,407,557
1987	707	187	1,388	516	1,490	12,384	41,486	40,467	8,798	580	84	89	108,176
1988	3	17	32,416	7,207	3,037	633	15,334	36,453	2,425	363	18	9	97,915
1989	41	466	709	2,139	35	15,568	17,357	32,969	2,361	0	125	0	71,771
1990	24	254	63	2,817	464	2,282	1,796	18,052	4,116	6	0	0	29,873
1991	7	0	23	31	115	8,028	13,816	19,395	863	0	0	0	42,278
1992	18	4,990	138	1,315	13,624	21,902	17,320	2,621	0	0	0	6	61,934
1993	0	0	199	1,743	1,726	946	8,935	18,233	3,823	3	96	0	35,705
Total	54,135	81,253	179,459	81,799	633,686	231,025	827,631	1,164,908	609,555	21,526	1,637	2,161	3,888,774

Table 34
Change in Chinook Salmon Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-195	-131	-467	-31,668	-32,892	-1,570	0	0	0	-66,923
1980	0	0	-466	-238	-27	-20	-60,802	-35,637	-12,304	-567	0	0	-110,061
1981	0	0	-102	0	-156	-1,689	-21,608	-12,312	-64	0	0	0	-35,930
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	0	0	0	-103,981
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-28,226	0	0	0	-79,064
1984	0	0	0	0	-6	-1,290	-24,188	-29,496	-25,410	0	0	0	-80,389
1985	0	0	-812	0	-362	-415	-13,751	-56,365	-9,911	0	0	0	-81,615
1986	0	0	-399	-190	-93,319	-15,144	-57,136	-57,399	-29,693	0	0	0	-253,281
1987	0	0	-63	0	-52	-2,167	-13,631	-11,139	-4,062	0	0	0	-31,114
1988	0	0	-2,402	-338	-320	0	-1,348	-14,700	-53	0	0	0	-19,162
1989	0	0	-52	-118	-9	-2,071	-770	-6,591	-148	0	0	0	-9,759
1990	0	0	-51	-99	-55	-372	0	-266	-1,273	0	0	0	-2,117
1991	0	0	0	0	0	-678	-3,919	-5,484	-500	0	0	0	-10,581
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,548
1993	0	0	0	-34	-67	-81	-1,957	-2,136	-205	0	0	0	-4,481
Total	0	0	-22,424	-6,073	-102,751	-35,090	-246,917	-356,022	-129,162	-567	0	0	-899,006

Table 35
Change in Chinook Salmon Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-195	-131	-467	-31,668	-32,892	-1,570	1,450	75	28	-65,370
1980	0	0	-466	-238	-27	-20	-60,802	-35,637	-12,304	-567	10	519	-109,532
1981	0	0	-102	0	-156	-1,689	-21,608	-12,312	-64	0	14	0	-35,916
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-28,226	284	0	0	-78,780
1984	0	0	0	0	-6	-1,290	-24,188	-29,496	-25,410	4	133	0	-80,252
1985	0	0	-812	0	-362	-415	-13,751	-56,365	-9,911	29	0	2	-81,584
1986	0	0	-399	-190	-93,319	-15,144	-57,136	-57,399	-29,693	784	0	0	-252,497
1987	0	0	-63	0	-52	-2,167	-13,631	-11,139	-4,062	-4	-1	-1	-31,120
1988	0	0	-2,402	-338	-320	0	-1,348	-14,700	-53	168	15	2	-18,978
1989	0	0	-52	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,753
1990	0	0	-51	-99	-55	-372	0	-266	-1,273	0	0	0	-2,117
1991	0	0	0	0	0	-678	-3,919	-5,484	-500	0	0	0	-10,581
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-34	-67	-81	-1,957	-2,136	-205	2	18	0	-4,461
Total	0	0	-22,424	-6,073	-102,751	-35,090	-246,917	-356,022	-129,162	2,181	274	551	-895,433

Table 36
Splittail Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				34	1,122	4,615	2,157	60,479	70,254	15,807	5,254	1,202	160,925
1980	72	86	1,310	56,194	61,187	1,621	6,020	140,563	187,723	45,984	9,770	1,318	511,847
1981	265	0	598	1,557	8,581	5,781	5,242	64,198	27,671	2,539	1,203	0	117,636
1982	0	290	1,577	32,429	44,207	13,705	5,413	45,730	169,164	193,840	121,238	4,172	631,762
1983	227	0	2,409	1,164	13,451	4,668	2,082	16,054	304,327	112,646	55,782	5,300	518,109
1984	1,477	36	63	96	3,945	7,479	5,640	9,307	56,464	46,887	10,337	1,060	142,790
1985	0	396	1,989	282	8,360	4,514	3,851	3,219	25,057	14,605	4,072	758	67,103
1986	286	1,103	0	246	2,281	7,461	74,203	971,878	1,095,083	29,690	14,404	7,452	2,204,087
1987	1,094	418	976	1,411	4,854	6,291	1,443	1,466	107,463	7,716	939	350	134,422
1988	34	13	3,581	23,499	3,589	638	1,901	2,999	2,434	1,268	20	168	40,145
1989	0	129	77	485	265	10,674	7,193	9,775	7,567	4,449	10,305	1,409	52,328
1990	49	48	7	1,279	1,932	3,197	322	3,224	11,623	1,071	0	0	22,752
1991	0	0	0	491	133	7,132	2,673	2,265	10,196	843	0	0	23,733
1992	78	0	25	485	4,324	3,247	181	244	2,508	0	88	3	11,183
1993	0	0	12	34,322	11,430	3,110	2,718	74,866	112,327	10,923	482	82	250,270
Total	3,581	2,519	12,623	153,974	169,661	84,134	121,038	1,406,268	2,189,862	488,266	233,894	23,273	4,889,093

Table 37
Change in Splittail Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				0	-26	-266	-474	-4,595	-10,819	0	0	0	-16,179
1980	0	0	-91	-1,613	-3,254	-69	-2,861	-12,446	-49,756	-10,584	0	0	-80,674
1981	0	0	-20	0	-299	-546	-2,541	-8,210	0	0	0	0	-11,616
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	0	0	0	-40,821
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-44,822	0	0	0	-60,511
1984	0	0	0	0	-218	-1,114	-1,615	-1,609	-6,445	0	0	0	-11,001
1985	0	0	-69	0	-371	-339	-963	-1,602	-7,063	0	0	0	-10,407
1986	0	0	0	-10	-356	-1,256	-16,567	-245,553	-169,939	0	0	0	-433,682
1987	0	0	-60	0	-178	-1,208	-389	-373	-54,289	0	0	0	-56,497
1988	0	0	-259	-867	-666	0	-136	-1,378	-614	0	0	0	-3,920
1989	0	0	-7	-32	-83	-1,351	-104	-2,308	-670	0	0	0	-4,555
1990	0	0	-6	-44	-252	-596	0	-111	0	-58	0	0	-1,068
1991	0	0	0	0	0	-668	-648	-825	-5,886	0	0	0	-8,028
1992	0	0	0	-35	-642	-839	-22	0	0	0	0	0	-1,537
1993	0	0	0	-959	-457	-298	-648	-6,489	-1,910	0	0	0	-10,763
Total	0	0	-1,322	-5,298	-14,036	-11,357	-28,759	-304,034	-375,810	-10,642	0	0	-751,259

Table 38
Change in Splittail Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				0	-26	-266	-474	-4,595	-10,819	2,979	778	71	-12,351
1980	0	0	-91	-1,613	-3,254	-69	-2,861	-12,446	-49,756	-10,584	2,198	341	-78,134
1981	0	0	-20	0	-299	-546	-2,541	-8,210	0	0	16	0	-11,600
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-44,822	9,261	4,804	194	-46,251
1984	0	0	0	0	-218	-1,114	-1,615	-1,609	-6,445	8,776	1,941	208	-75
1985	0	0	-69	0	-371	-339	-963	-1,602	-7,063	383	78	20	-9,925
1986	0	0	0	-10	-356	-1,256	-16,567	-245,553	-169,939	19,755	3,198	1,472	-409,257
1987	0	0	-60	0	-178	-1,208	-389	-373	-54,289	13	63	89	-56,332
1988	0	0	-259	-867	-666	0	-136	-1,378	-614	724	16	32	-3,147
1989	0	0	-7	-32	-83	-1,351	-104	-2,308	-670	205	455	79	-3,815
1990	0	0	-6	-44	-252	-596	0	-111	0	780	0	0	-230
1991	0	0	0	0	0	-668	-648	-825	-5,886	490	0	0	-7,539
1992	0	0	0	-35	-642	-839	-22	0	0	0	50	0	-1,487
1993	0	0	0	-959	-457	-298	-648	-6,489	-1,910	585	76	14	-10,088
Total	0	0	-1,322	-5,298	-14,036	-11,357	-28,759	-304,034	-375,810	47,272	34,061	2,687	-656,597

4.0 Effect Assessment Approach for Non-Project Reservoirs

There are several non-Project reservoirs that could serve as potential water sources for the EWA. Because these non-Project reservoirs are not managed under the operations of either the CVP or SWP, they are not included in the modeling simulations described above. As such, another method of evaluating the potential effects from EWA actions was developed to analyze possible EWA-related effects on these non-Project reservoirs.

4.1 Assumptions for Non-Project Reservoirs

The following assumptions have been established with regard to the status and operation of the non-Project reservoirs. These assumptions were applied to the analysis for each of the non-Project reservoirs where the EWA could purchase water (see Chapter 2 of the EWA EIS/EIR).

- Non-project reservoir operations will continue to function under the same set of demands and assumptions that have previously been employed by each system in earlier years, including reservoir drawdown to targeted storage levels.

- Analysis relating to the timing, magnitude, and duration of water transport activities and their potential effects on riverine flow processes will be developed using a monthly time-step, culminating at the end of the water year in late-September. Where applicable, the period of time that will be used to evaluate resource-specific effects (e.g., fisheries, vegetation and wildlife) will concur with the timeframe associated with potential asset transfers, as identified in the modeling output.

- EWA asset availability from non-Project reservoirs and any associated potential effects will be evaluated by reviewing hydrologic data and reservoir specific area-capacity curves to predict changes in surface water elevation and reservoir refill frequencies. This information will provide an indication of the target storage capacities, minimum pool volume, and range of surface water elevations under normal operating conditions, and the probability of annual refill for each reservoir. Estimations for flow changes will be translated into relative changes in surface water elevations and will be used to evaluate resource specific effects.

Limitations have been placed on the maximum volume of water potentially available to EWA from each non-Project reservoir, based upon reservoir size, operational constraints and the existing refill patterns within each basin. Additionally, EWA asset acquisitions must not result in a reduction of reservoir surface water elevation beyond the minimum reservoir drawdown levels as stated in the corresponding FERC license, where applicable. This documentation and any related materials would also be reviewed to ensure compliance with all appropriate regulatory requirements.

The following discussion describes how EWA actions are expected to utilize and influence storage capacities of the non-Project reservoirs. This discussion serves as a description of the most utilitarian implementation of non-Project reservoir water supplies that could be used as potential EWA assets. It is intended to provide the set of conditions describing the relationships between each non-Project reservoir and the Proposed Action (Flexible Purchase Alternative), as applied in all resource-specific effect analyses.

4.1.1 Placer County Water Agency (WA) Non-Project Reservoirs

EWA assets may be acquired from two reservoirs under Placer County WA management, French Meadows and Hell Hole Reservoirs. Placer County WA's ability to sell water to EWA is also dependent upon PG&E objectives and operations. The decision to sell water to the EWA is dependent upon two factors: 1) the normal combined operational drawdown level (typically 150 TAF) that is maintained for both reservoirs; and 2) FERC minimum requirements for combined carryover storage, which are stated as 50 TAF.

When available, EWA would only purchase 20 TAF annually from Placer County WA, with the assumption that reservoirs would be refilled on an annual basis. Under the most severe conditions, refill may not occur. In that event, 20 TAF may be purchased within two sequential years for a total asset acquisition of 40 TAF. With regard to French Meadows and Hell Hole Reservoirs, if both reservoirs had a combined water debt of 40 TAF, EWA would not purchase additional water from Placer County WA until all or part of the 40 TAF was replenished. If only a portion of the 40 TAF were refilled, any new EWA acquisition that could be purchased would only be up to the volume of water refilled, not to exceed the original total of 40 TAF. Imposing a limit of a 40 TAF total reduction on EWA asset availability also serves as a conservation measure to ensure that reservoir storage is not depleted below historic levels.

4.1.2 Oroville-Wyandotte Irrigation District (ID) Non-Project Reservoirs

Under normal operating conditions, combined winter baseline storage during November and December is around 60 TAF in Little Grass Valley and Sly Creek Reservoirs, with approximately 80 percent of storage (48 TAF) in Little Grass Valley Reservoir and 20 percent of storage (12 TAF) in Sly Creek Reservoir. Minimum reservoir storage for each water body is set at 500 AF, according to FERC requirements. There are refill criteria for this system. Although the reservoirs refill annually, a debt to the SWP could occur if the stored water could have been utilized by the SWP absent the EWA acquisition. Oroville-Wyandotte ID may have up to 15 TAF of water assets available to EWA from Little Grass Valley and Sly Creek Reservoirs.

4.1.3 Yuba County Water Agency Non-Project Reservoirs

Yuba County WA may be able to provide EWA with up to 100 TAF of stored water from New Bullards Bar Reservoir. Yuba County WA could sell stored reservoir water to the EWA as long as local needs, instream flows, and system demand requirements were met. This action would result in a reduction in the volume of stored water in New Bullards Bar Reservoir and would cause a decrease in surface water elevation of approximately 29 feet. Under the minimum surface water utilization scenario, New Bullards Bar Reservoir storage would be decreased by 30 TAF, thereby providing EWA with up to 30 TAF in asset acquisitions by the end of September.

Unlike the other non-Project reservoirs operated by Placer County WA and Oroville-Wyandotte ID, there is a possibility that Yuba County WA transfers could result in an effect caused by changes in downstream operations. Depending upon Delta conditions and the effect of the transfer on Lake Oroville, there may be a need to increase releases from Lake Oroville in order to compensate for the reduced flows into the Delta during periods of time when New Bullards Bar Reservoir is being refilled upstream. Under these conditions, Oroville Reservoir operations may need to be altered to accommodate downstream demands in the Delta. While Lake Oroville surface water elevations would remain within the range of targeted storage levels, the operational response associated with releasing additional water might be regarded as a change in project operations. This response might be considered a result indirectly arising from EWA actions.

5.0 References

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